VOLUME XII September, 1924 NUMBER 3

Medical Lib SEP 26 1924

[FOUNDED IN 1906 AS THE AMERICAN QUARTERLY OF ROENTGENOLOGY]

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

OFFICIAL ORGAN
THE AMERICAN ROENTGEN RAY SOCIETY
THE AMERICAN RADIUM SOCIETY

Editor: ARTHUR C. CHRISTIE, M.D.

EDITORIAL BOARD

JAMES T. CASE, M.D. H. K. PANCOAST, M.D. WILLIAM DUANE, PH.D.

ADVISORY BOARD FOR PATHOLOGY

JAMES EWING, M.D. Cornell University
EUGENE L. OPIE, M.D. University of Pennsylvania
ALDRED S. WARTHIN, M.D. University of Michigan

PUBLISHED MONTHLY BY PAUL B. HOEBER, INC.
67-69 EAST 59TH STREET · NEW YORK, N. Y.

CENTRAL SECTION—*Sixth Annual Meeting*, Detroit, Mich.
February 20 and 21, 1925

RADIUM EMANATION
DEPENDABILITY · · SERVICE · · RELIABILITY

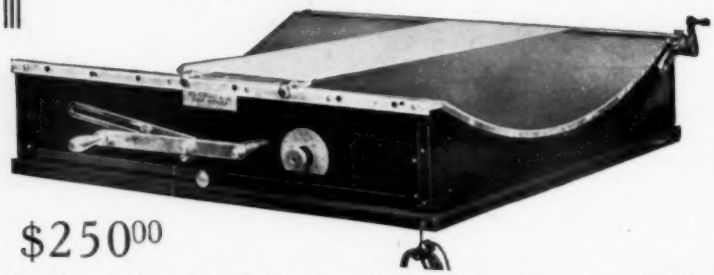
DELIVERIES ON SHORT NOTICE. COSTS MODERATE

THE RADIUM EMANATION CORPORATION
256 WEST 57th STREET Telephone Circle 3649 NEW YORK CITY

[SEE PAGE ADVERTISEMENT FACING BACK COVER]

Entered as second-class matter, March 3, 1916, at the Post Office, New York, N. Y., under the Act of March 3, 1879.
YEARLY SUBSCRIPTION, $10.00 SINGLE NUMBERS, $1.50

BRADY'S POTTER-BUCKY DIAPHRAGM



$250.00

NEW FEATURES

A new and improved type of grid construction that secures even more brilliant results than our previous grid.

A neat compression band attachment for holding the patient still during exposure.

Patient brought nearer to plate.

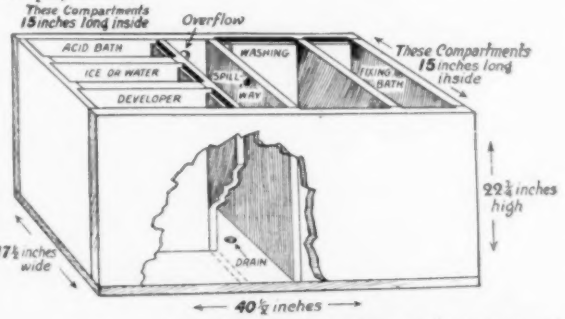
An electrical contact device for operating a signal lamp or which can be connected to most time switches for making the exposure automatically, from 1 to 90 seconds time at $5.00 extra charge.

Our speed control is accurate and reliable and timed in actual seconds. It does not require constant repairs. We claim it is the smallest, neatest and most effective Bucky on the market, 6:1 ratio grid cutting off practically 90% of secondary. Takes all makes of cassettes to 17 x 17 size, operates in horizontal or vertical position, and does Stereoscopic work in either direction.

All-metal construction electrically welded and practically indestructible. They do not get "out of date." Price $250.00 list with cash discount for quick payment.

DEVELOPING TANKS

Our stone tanks are considered the best designs and values on the market. Each has a space for ice or hot water for controlling the developing temperature. The 5 and 6 compartment styles also have a 4" air space to prevent temperature of wash water from affecting the temperature of developer. Lengths over all 24½"-34"-40¼" respectively. Illustration shows our regular 6 compartment style. Special styles to order. We have many sizes of enamel tanks also. Send for special circular.



	4-compartment	5-compartment	6-compartment
Prices shipped from Virginia : : : : : :	$45.00	$53.50	$60.00
Prices shipped from Chicago, Boston or Brooklyn : :	$50.00	$58.50	$65.00

DR. GRANGER'S SINUS MASK

For radiography of the sphenoid, etc., at 17° angle. We furnish these to fit all standard makes of cassettes. Specify outside size of your cassette when ordering. Made for 8 x 10 only. Price $8.50.

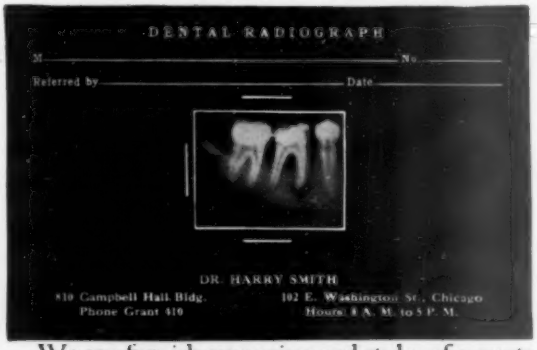
INTENSIFYING SCREENS

Get our net prices on screens either alone, or mounted in cassettes. It may save you some money. We are distributors on Buck X-Ograph cassettes, and carry the standard makes of screens.

BARIUM SULPHATE (Paragon)

We have furnished enormous quantities of this to the profession during the last 10 years. We are prepared to furnish this in prepared form with malted milk or dry milk incorporated at $30.00 per 100 lbs. packed in 25 lb. sealed tin cans. 5 lb. & 10 lb. sizes also available. Price of regular barium $24.00, fluffy style $26.00 per hundred.

DENTAL FILM MOUNTS



We can furnish many sizes and styles of mounts in cardboard or the all-celluloid types. Special designs if desired. Very liberal discounts are allowed on orders for 100 or more. Get our new price list #160—with discounts.

Special on gross lots of #1 size film $6.96.

ASK FOR OUR LATEST PRICE LIST AND DISCOUNTS

GEO. W. BRADY & CO., 761 S. WESTERN AVE., CHICAGO

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. XII SEPTEMBER, 1924 No. 3

SOME OBSERVATIONS ON SHORT WAVE ROENTGEN THERAPY

BY GEORGE W. HOLMES, M.D., AND RICHARD DRESSER, M.D.

Roentgen Laboratory, Massachusetts General Hospital,

BOSTON, MASSACHUSETTS

IN this article we shall attempt to outline briefly our technique of operation, the organization of the treatment clinic, and a few of the immediate results obtained.

The high voltage machine is of the so-called "booster" type, that is, the current is rectified at a comparatively low voltage, and is then stepped up by means of two auxiliary transformers. This arrangement presents a number of advantages. There is very little noise, so that a specially constructed, sound-proof room is not necessary. In the transformer room itself, there is but slight odor and gas. By means of a high tension switch, the booster transformers may be cut out of the circuit, and the machine used for low-voltage treatment, or even roentgenographic work if necessary. The machine has the disadvantage of delivering a slightly low intensity, although for a given voltage, the wave-length and depth dose are practically the same as obtained with installations which rectify at the full voltage.

FIG. 1. Treatment couch lined with ¼ inch lead, showing top and side openings.

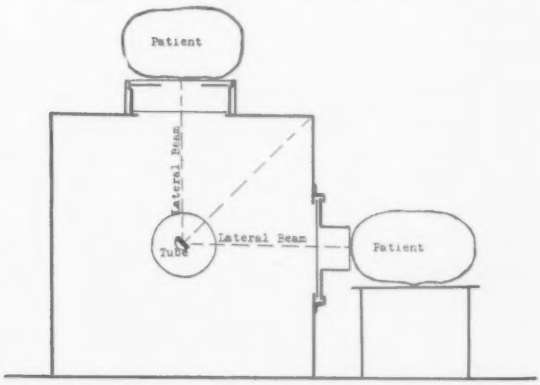


FIG. 2. Schematic cross-section of treatment couch at level of tube, showing method of treating two patients at once.

The tube is placed in a lead-lined couch below the patient, as shown in Figures 1 and 2. At first, we had but one opening, located in the top of the couch. We soon found, however, that this arrangement did not meet all of our requirements. In treat-

ing anterior areas, it was necessary for the patient to lie face down, and for many this was impossible. We then made an opening in the side of the couch from which a small cone projected. Anterior areas could then be treated with the patient lying on either side, the couch beneath him being adjusted as to height by means of jacks. The small projecting side cone allows easy access to neck and axillary areas. The size of the field, at the top and side, is regulated by lead diaphragms, which can be removed easily, or slipped into place. The openings in these diaphragms are of standard sizes—10 × 10, 15 × 15, 15 × 20, and 20 × 20 cm. Between the patient and the diaphragm is placed a celluloid plate 4 mm. thick. This prevents the patient's sinking into the opening, and effectively cuts off any secondary radiation from the lead. The distance from the target of the tube to the celluloid plate is exactly 50 cm. both top and side.

At first we treated only one patient at a time, but our clinic grew rapidly, and soon we were unable to accommodate all the cases. This led us to make some measurements of the lateral beam, the target of the tube being directed as shown in the figure. We found practically no difference in intensity between the direct and lateral beams. The wave-length was the same in both cases, and the depth dose measured in a water-phantom was the same. We then began treating two patients at a time, one on top of the couch, and one at the side. The clinical results were in accord with the physical observations.

The advantages of this type of installation are obvious. The couch encloses all of the high tension circuit, and the lead lining is well grounded, thus affording absolute protection from electrical shock, and undesirable scattered radiation. The patient can be placed quickly and easily in position, and he is not subjected to the discomfort of a heavy covering of leaded rubber, which at best serves as only partial protection against the short wave-lengths. The treatment room is absolutely free from noxious gases and odors. Radiation sickness is greatly diminished. The control cabinet is placed behind a leaded wall, so that the operator is safe from secondary radiation arising from the patient's body. The tube and high tension meters may be observed in a mirror placed behind a lead glass window, and the sphere-gap control is located conveniently so that it may be operated without entering the treatment room.

The machine is operated at 200 kv. (sphere gap), 4 ma., 50 cm. focal-skin distance, 0.5 mm. copper plus 2 mm. aluminum filter. This setting with the average tube gives an effective wave length of 0.155 Å, and a depth dose of 35 per cent at 10 cm. when a large (20 × 20) field is used. This dose compares very well with recent observations made on other installations by Glasser, who measured 34.5 per cent with the same setting.

With a well broken in tube, the intensity delivered under the above conditions is 0.148 E.S.U. measured without the patient on the table. A mild erythema is obtained by 800 E.S.U. seconds (measured without the patient). This makes the erythema time, using a large field, 90 min. The increase in surface dose due to scattering and secondary radiation is 35 per cent, making a total of 1080 E.S.U. seconds, actually received by the skin when the patient is given a full erythema dose.

We are using three types of ionization-measuring instruments: The Duane galvanometer; the Friedrich iontoquantimeter; and the Dessauer electroscope. All of them have their advantages and disadvantages.

The Duane instrument, when working properly, is handled easily, is accurate, and the wave-length and intensity measurements can be made in a few minutes. The D'Arsonval galvanometer which is used for measuring the current is, however, an extremely delicate piece of apparatus, and great care must be taken that it be installed so as to be free from the slightest jar or vibration. When once broken, it has been our experience that it takes several months to get it repaired. The Duane machine takes no account of variations in intensity which may occur during the course of the treatment, since the reading is instantaneous, and does not involve a time element, as do instruments

depending upon an electroscope for measurement of the ionization current.

Friedrich's iontoquantimeter possesses the advantage of a comparatively small ionization chamber which may be placed below the patient during the treatment, and which can be inserted into body cavities (vaginal measurements in pelvic cases), and is useful in water-phantom measurements. It possesses the disadvantage of a large "natural leak" which must be determined frequently and corrected for. We have been able recently to improve this leak by changing the sulphur insulation in the cable. Measurements take a considerable length of time, although it is of some advantage to be able to measure the dose continuously throughout the treatment.

The Dessauer electroscope possesses the advantage of simplicity and stability. The natural leak is so small that it may be disregarded. The readings consume a matter of only a few seconds, although it takes some time to line the instrument up with the tube, and this must be done carefully. Wave-length measurements made with this machine check exactly with measurements made with the Duane instrument. The cost of this apparatus is about one-half that of the Friedrich and Duane types.

None of these instruments is fool-proof, and reliable data can be obtained from them only after considerable experience in their handling.

It has been our practice to check up our machine each morning with the Duane galvanometer, adjusting the milliamperage and voltage so that we get an intensity of 0.148 E.S.U., and an effective wave-length of 0.155Å. This keeps the time of treatment constant. Our first tube ran about three months, a total of 600 ma-hr., and during this time we were able to obtain, as a rule, the above intensity by using 4 ma. Toward the end of this period, however, the milliamperage had to be increased gradually until, when the tube punctured, we were running 5 ma. to get 0.148 E.S.U. intensity, that is, our erythema dose was 450 ma-min. A new tube was put in place, and an intensity measurement taken. It now required only 3.5 ma. to give us the 0.148 E.S.U., the erythema dose being only 315 ma-min. At the end of several weeks, the milliamperage had to be raised to 4, where it remained constantly. At no time was there any appreciable difference in the effective wave-length of the two tubes. This shows the great importance of ionization measurements when any change in the apparatus is made. This applies to rectification, etc., as well as to tubes.

In using various ground and measuring filters, supposedly of the same thickness, and all obtained from reliable roentgen-ray firms, we found some little difference in both wave-length and intensity. This led us to measure our filters with a micrometer, and we found that they varied in thickness not only with one another, but different parts of the same filter showed slight variations. To obtain the average thickness, we used the weight, area and density formula,

$$\frac{\text{weight in grams}}{\text{area in sq. cm.} \times \text{density}} = \text{thickness.}$$

This showed that our copper filters ranged from 0.48 to 0.53 mm. in thickness, although they were all represented as being 0.50 mm.

In an endeavor to obtain the most effective setting for our machine, we performed the following experiment: Keeping the filtration, milliamperage, and distance constant, the kilovoltage was lowered from 200 to 120, ten points at a time, the effective wave-length and intensity being measured with the electroscope at each drop. The results are graphically recorded in Figure 3.

The treatment clinic is under the direction of the chief roentgenologist, who is aided by a first and second assistant. A house officer serves a period of about three months in the clinic, and then rotates to another branch of the roentgen-ray department. The actual operation of the machines and the care of the radium are placed in charge of a graduate nurse, and are also closely supervised by the house officer. A consultation clinic with specialists in the various branches of medicine and surgery is held daily, and additional information and advice about the various types of cases are thus obtained. These

clinics include internal medicine, with special reference to blood diseases; gynecology; general surgery; nose and throat; and dermatology. A special thyroid clinic meets once a week in which cases are seen by the surgeon, internist, and roentgenologist.

It is the duty of the house officer to go thoroughly into the records of each new case collecting data as to history, physical findings, operative reports, pathological examinations, etc. The case is then seen by the chief roentgenologist, or his assistant, and the treatment decided upon. The depth dose is calculated, in most cases, by means of isodosis charts, and the blood count is followed carefully. The house officer is responsible for the proper carrying out of the treatment recommended, and he applies the radium when this form of therapy is decided upon.

When the high voltage machine was first put into operation, it was our practice to give a full erythema dose to an area in one sitting, repeating this dose over another area a day or two following. We found, however, that this heroic treatment was not well borne, most patients suffering considerable discomfort, and not infrequently severe roentgen sickness. At present we are giving, in most cases, one-half an erythema dose at a sitting, repeating this every day or every other day until the series is finished. This extends the total time of radiation over a period of from ten days to two weeks.

Another important factor in radiation sickness is the size of the portal of entry. The patients apparently suffer much less discomfort when the smaller fields are used. For this reason, we are now inclined to use the smaller fields, even at a sacrifice of depth dose.

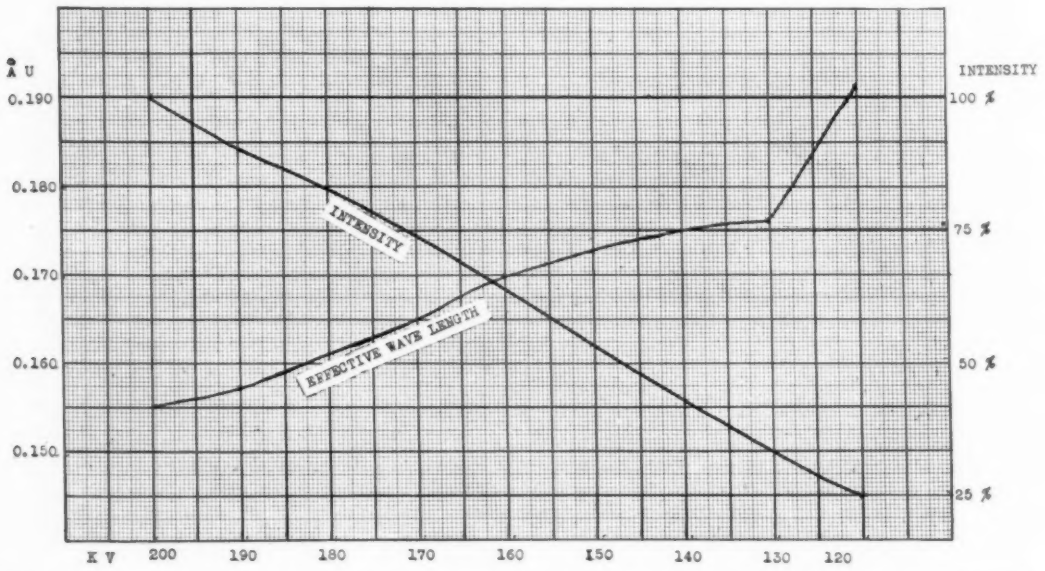


FIG. 3. Filter, 0.5 mm. Cu plus 2 mm. Al, ma. 4. Focal skin distance, 50 cm. All factors constant except voltage.

A question which is paramount in radiation therapy, both in the interest of the patient, and in the reporting of reliable results, is that of correct diagnosis. The following case illustrates the difficulties which may arise in this connection.

CASE 2660. Mrs. D. L. Middle-aged woman, very obese, with cancer of the breast. It was considered operable, but the postoperative report was rather unsatisfactory. First seen on March 20, 1922. Between this date and May 2, she was given 7 exposures of medium length (aluminum filtered) roentgen rays. There was no roentgen sickness, and the treatment was followed by a definite tan. Plate taken of chest before starting treat-

ment was negative. In July she returned with swollen arm, and treatment was repeated, the rays being directed over the shoulder and axillary region. This was followed by some relief. Tanning was fairly well marked, and she did well until November when her daughter reported that she was suffering from dyspnea and pain in the chest. A roentgenogram showed definite pathological change in the lungs which was thought to be of metastatic origin. There was no evidence of recurrence in the skin. The arm was swollen, and she was weak and extremely orthopneic. Between November 3 and 13, she received a full erythema dose over the front, back, and sides of the chest with the 200 kv. technique. On account of the marked orthopnea, considerable difficulty was experienced in giving the treatments. There was no roentgen sickness whatsoever, and following the series there was a most remarkable improvement both in the symptoms and in the chest findings. A second series was given in January, followed by still more marked improvement. At the present time, the patient has some dyspnea, and is beginning to lose ground, but she is still up and about.

We should feel considerable hesitancy in reporting this case as one of metastatic pulmonary cancer. It is the only case in our series which has responded so readily to radiation, and in which palliative results have been so quickly obtained. In all probability our diagnosis of the etiology of the pulmonary condition was wrong. Undoubtedly, many of the remarkable cures which have been reported in this field are not cures at all, but mistakes in diagnosis.

One of the largest, and most interesting groups is that of Hodgkin's disease.

As a general rule we are still treating the superficial glandular manifestations with the longer wave therapy (4 mm. Al filtration) using the short waves on only the mediastinal and abdominal processes. Mediastinal symptoms are in most cases controlled by about one -half an erythema dose over the front and back of the chest, using a large-sized field. In some of the first cases treated, we gave this one half erythema dose in one treatment. Several of the patients stood this very well, but there were a number of very severe reactions, one of them proving almost fatal. At present we seldom give more than a sixth of an erythema dose at one sitting when treating a case of Hodgkin's disease over the mediastinum or abdomen. The total dose is the same in most cases, but its administration is spread over a longer period. With this technique we get very little roentgen sickness, and the neoplasm disappears as quickly.

We were also able to control mediastinal Hodgkin's disease by the older method, using an 8 or 9-in. spark gap, 4 mm. Al filtration, and $\frac{1}{16}$-in. target skin distance. To get results it was usually necessary to give a full erythema dose to the anterior and posterior chest areas. Recently we have made an effort to determine the actual amount of radiation delivered into the deeper mediastinal structures with the longer wave technique, that we might compare it with the amount received under short wave therapy.

Using a 9-in. spark-gap and 4 mm. Al filter, we measured the effective wave-length, and obtained the result 0.28 Å. Using a 16-in. target-skin distance and 20 × 20 cm. field, phantom measurements with the iontoquantimeter gave a dose of 20 per cent at 20 cm. depth. A chest 20 cm. thick receiving a full erythema dose front and back at a target-skin distance of 16 in. (40.6 cm.) with an effective wave-length of 0.28 Å. would get at its central point a depth dose of about 40 per cent. The same chest radiated front and back with our short wave setting (0.155 Å.), but receiving only one-half an erythema dose over each area would get at its central point a depth dose of about 35 per cent. Thus with the two methods we are apparently giving about the same depth dose, and getting the same depth results, but with the shorter waves we stay well below the skin tolerance point—none of our cases has yet shown the slightest tan—and we believe that we get very much less roentgen sickness.

ROENTGEN-RAY TREATMENT OF SYRINGOMYELIA. REPORT OF ONE CASE

BY A. S. MERRILL, M.D.

Assistant Roentgenologist, Massachusetts General Hospital

BOSTON, MASSACHUSETTS

THE name "syringomyelia" is generally taken to mean a condition characterized by muscular wasting of the Aran-Duchenne type, loss of thermic and painful sensations and preservation of tactile sensibility.

Lesions are generally found in the cervical and upper dorsal cord but may involve any part and even the medulla, pons and internal capsule.

The lesion, accompanied by cavity formation, has a predilection for the grey matter, especially the posterior part of the dorsal horns but frequently involves the white matter. Its distinguishing features are asymmetry and irregularity. The cavities are often filled with detritus from colliquative necrosis and fluid. Microscopically they are bounded by a zone of delicate neuroglia, rarely lined with connective tissue said to be derived from the pia, occasionally lined with ependymal epithelium. The extent of the glial hyperplasia varies widely. Vessels show hyaline degeneration and thickening of the intima.

The lesions are generally accepted as due to a primary hyperplasia of neuroglia followed by a degenerative softening and cavity formation. It is regarded as a central gliosis caused by a proliferation of the ependymal. cells. The vascular changes, thickening, thrombosis, embolism and hemorrhage, being responsible for the softening which is largely a necrosis from lack of nutrition.

Virchow believed that the disease was consecutive to hydromyelia and that the gliosis was due to the proliferation of embryonic cells about the central canal. Such embryonic cells may take the form of diverticula from the canal, solid masses or isolated cavities.

Ewing states that "in a group of cases a definite gliomatous process is associated with syringomyelia at one or both poles of the tumor." He speaks of Saxer's case where the central portions of the tumor were lined with neoplastic endothelium, and a case of Strauss in which was a "low-grade but definite tumor process leading to syringomyelia by central softening." He says also: "In an important group of cases a pronounced central gliosis is associated with syringomyelia. Definite histological features of neoplastic growth are lacking but not more so than in some slowly growing diffuse gliomas of the brain. Some regard the process as a true neoplasm while others consider it a form of inflammatory gliosis. There is no doubt that pronounced gliosis is occasionally associated with extensive cavity formation. On the other hand, syringomyelia may result from many processes not connected with tumor growth. Syringomyelia occurs in the course of central glioma, but unless the structure of the process is clearly gliomatous the case should not be classed in that category."

On the theory that the gliosis may be due to a neoplastic proliferation of cells of an embryonic type, and that such cells should show a susceptibility to radiation, we have attempted its treatment by deep roentgen therapy.

The literature on the subject is not extensive. Raymond, among the earliest (1906) called attention to this method of treatment demonstrating a marked improvement in a young girl treated by Oberthur and Delherm in 1905. Gramegna (1906) reported two cases relieved. Lejonne and Egger report a case in 1906. Beaujard and Lhermitte (1907) state that "the use of *x*-rays may modify entirely the clinical course of the disease, give much improvement and totally change the prognosis." They describe an unpublished case treated by Menetrier and Béclère, with great improvement. They report 3 cases all benefited, and find that the earliest and most rapid change is in the motor symptoms, accompanied by a gain in strength. Then the sensory symptoms became mark-

edly diminished. The trophic disturbances were arrested. Atrophied muscles showing complete degeneration were unimproved; those showing beginning degeneration regained their strength. Complete return of tactile sensibility showed that changes had occurred in the grey matter itself. The thermo-analgesia disappeared in the same areas.

Lhermitte (1921) emphasizes the absence of neoplastic elements in the cavities following hydromyelia, softening and necrosis, or hemorrhage but believes that there is one variety of syringomyelia with proliferation of neuroglia about the cavities and remote from them and that this variety is amenable to roentgen radiation. He finds the subjective symptoms the first to subside with improvement in the use of the limbs. Muscular atrophy being the direct result of destruction of the grey matter, is not modified but its progress may be arrested. Bone and joint disturbances may retrogress. The treatment causes actual retrogression of the lesions, not mere remissions in their course. He reports an autopsy on a case treated by him in 1914. Scarcely a trace of gliomatous process remained in the area treated while it was pronounced in untreated areas. Unfortunately the form of syringomyelia cannot be differentiated except perhaps by the effects of roentgenotherapy.

Coyon, Lhermitte and Beaujard (1922) review the subject of syringomyelia and its treatment and describe the pathological findings in the cord after death from intercurrent disease.

In our clinic the treatment of 9 cases has been attempted but only two persisted long enough for any conclusions to be drawn. One case, a young woman with very marked symptoms showed some improvement and apparent arrest of progress after two years but it is our opinion that a too limited area of the spine was exposed, the area covering only the cervical and upper two or three dorsal vertebrae. It was intended to continue treatment but she did not return.

The other case was attended by such marked improvement that it seems worthy of report.

Case Report. M. E. C., female, white, aged twenty-four, admitted June 2, 1915. *Family history*, unimportant. *Past history*, not remarkable.

Present illness began about fourteen months before admission with wasting of the right hand, numbness of right side of the hand and arm almost to the axilla. For about a year the weakness of the right hand and arm was progressive with muscular incoordination. Has been unable to hold anything firmly, drops household articles and can do little or no work.

Physical examination shows a well-developed and nourished young woman. Pupils wide, react to light and distance. Facial and ocular muscles normal. Tongue and palate normal. Motor 5th normal. Right arm shows atrophy of all smaller muscles. Atrophy also of all muscles of the right hand especially thenar and hypothenar eminences. Right forearm smaller than the left. Diminution of touch, pain and thermal sensations on inner aspect of right upper and lower arm. Biceps, triceps and periosteal reflexes normal on both sides. Lower extremities show no disparity in size and no abnormalities of reflexes or sensations. The Wassermann reaction was negative.

July 9, 1915. All sensations about as at first examination. Touch normal except area on inner surface of right arm.

August 6, 1915. Felt beginning loss of sensation in right breast and right side. The disease was evidently progressing.

October 11, 1915. The area over right breast has extended somewhat.

October 22, 1915. Roentgen-ray treatment of dorsal and cervical spine begun.

January 12, 1916. Apparent improvement in thermic sensation over chest.

January 19, 1916. Right leg slightly smaller than the left. Calf and suprapatella regions ½ to ¾ inch smaller. Eight inches above the patella there is no difference. Some sensory disturbance on inner aspect of right thigh.

March 4, 1916. Believes she is better. *Physical examination* shows pupils equal, react to light and distance, no definite ocular abnormality. Motor and sensory reactions of face normal. Tongue and pharynx normal. Hearing equal and normal. Sterno-mastoids normal. Atrophy and weakness of right arm and hand as

before. Sensation of touch normal over whole back. Recognizes prick, heat and cold. Recognizes prick over inner aspect of right hand and arm but less acute than over outer aspect. Generally much improvement over last examination. Heat and cold sometimes recognized over inner aspect of right arm but not satisfactorily. Reflexes of legs normal. Roentgen-ray treatment continued.

November 16, 1916. In the opinion of the neurological department the disease has been stationary for several months. She feels very well and much encouraged. The most atrophied muscles remain as before, but there has been no advance nor increase in the affected areas and no new muscles are involved. The outer muscles are stronger, coordination is better and little or no pain is felt. Discharged for four months under observation.

February 9, 1917. No evident progress of the disease. Another series of roentgen-ray treatments advised.

June, 1918. No evidence of progress of the disease.

January, 1920. No evidence of progress of the disease. The atrophied muscles remain the same. No new muslces involved. The less affected muscles are stronger and coordination is good. Grasp is strong and sure. Holds things securely and can do many things impossible before. Areas of sensory disturbances are diminished. Has no pain. General condition is excellent.

July 27, 1921. From neurological records. "Careful examination today shows perfect perception of very slight changes of temperature and prick except in ulnar region of hand and running a short distance up the inner aspect of the forearm. The case not only seems arrested but there is great functional improvement. Is now doing secretarial work steadily."

February, 1924. The patient was seen and although no complete neurological examination was made her condition seemed unchanged since the last observation and no subjective nor objective evidence of recurrence was apparent.

The treatments as given according to the technique of that time were distributed over the whole cervical and dorsal regions. Areas about three inches square were laid out along either side of a line through the spinous processes and the rays directed from each side so as to converge at the spinal canal. Six areas were exposed at a sitting. A regular 7-in. broad focus Coolidge tube was used with 5 ma., a penetration of 8 to 9 Benoist at a target-skin distance of 10 inches through 3 mm. of aluminum to the limit of skin tolerance. Frequently a slight erythema resulted and the same area was not exposed again until this had subsided. The whole surface showed a general light tanning, and capillary telangiectasis subsequently developed over the dorsal region. In all, sixteen sittings were given, making an average of nine exposures to each area.

CONCLUSIONS

1. The syndrome known as syringomyelia being the manifestations of nerve disturbance from cord lesions of similar character but of diverse pathological origin, the nature of the underlying pathology cannot be determined during life.

2. As some, at least, of the cases are probably due to a neoplastic change they may be affected favorably by roentgen radiation.

3. As no other form of treatment appears to change the course or progress of the disease roentgen radiation is advisable.

4. The results in a few cases appear to confirm this theory.

BIBLIOGRAPHY

GRAMEGNA, A. Sulla tecnica della radioterapia degli strati profondi. *Gior. d. r. Accad. di med. di Torino*, 1905, 4.s., xi, 736–742.

GRAMEGNA, A. La radioterapia della siringomielia; nota di tecnica sulla radioterapia del midollo spinale. *Rev. crit. di clin. med., Firenze*, 1906, vii, 717–722.

RAYMOND, F., and GUILLAIN, G. Un cas de syringobulbie; syndrome d'Avellis au cours d'une syringomyélie spasmodique. *Rev. neurol., Par.*, 1906, xiv, 41–45.

LEJONNE and EGGER. Un cas de syringomyélie à localisation poliomyelique postérieure. *Rev. neurol., Par.*, 1906, xiv, 273–275.

BEAUJARD, E., and LHERMITTE, J. La radiotherapie de la syringomyélie. *Semaine méd.*, Par., 1907, xxvii, 193–197.

IVANOFF, N. S. Roentgen ray treatment of syringomyelia. *J. nevropat. i psikbiat . . . Korsakova, Mosk.*, 1910, x, 1047–1068.

ALLAIRE and DENÈS. Traitement de la syringomyélie par les Rayons X. *Gaz. méd. de Nantes*, 1912, 2.s., xxx, 997–1005.

KUTUZOFF, L. M. Syringomyelia, its treatment, especially its radiotherapy. *Noroye v Med., S.-Peterb.*, 1912, vi, 193–203.

RUPIN, A. Contribution à l'étude du traitement radiothérapique de la syringomyélie et des affections non traumatisées de la moelle. Montpellier, 1913, 78 p. No. 84.

NORDENTOFT, S. Roentgenotherapy of syringomyelia. *Ugeskr. f. Laeger*, 1917, lxxix, 1086.

LHERMITTE, J. Radiotherapy of syringomyelia. *Paris méd.*, 1921, xi, 281.

COYON, A., LHERMITTE, J., AND BEAUJARD, J. Radiotherapy in syringomyelia. *Bull. et mem. Soc. méd. d. hôp. de Par.*, 1922, xlvi, 387–396.

EWING, JAMES. Neoplastic Diseases. Second edition, W. B. Saunders Co., Philadelphia, 1922.

CLYMER, G. A case of syringomyelia treated by x-ray. *Arch. Neurol. & Psychol.*, 1922, vii, 139.

SOME OBSERVATIONS ON THE RADIATION TREATMENT OF CARCINOMA OF THE LARYNX*

BY HENRY K. PANCOAST, M.D.

PHILADELPHIA, PENNSYLVANIA

THESE observations were prompted by a serious consideration of the worthwhile results of radiation treatment in many conditions and the possibility of eliminating from an already overburdened field of endeavor as much unnecessary time-consuming work as possible. When the question of results in carcinoma of the larynx came up for discussion, we encountered two very striking facts: (1) that we had not been successful in curing a single proven case of squamous-cell carcinoma of the larynx by radiation alone and, (2) that some very successful results had, in recent years, been accomplished by surgical procedures, and sometimes in apparently hopeless cases of intrinsic carcinoma. We realized that a continuation of our endeavor to treat these cases by radiation had been stimulated by the apparently successful result so frequently encountered early in the treatment, but we had to admit an ultimate fatal recurrence in every instance.

If we consider the histological and anatomical characteristics of the larynx on the one hand, and the insidious and resisting nature of squamous-cell cancer, on the other, we can readily realize the difficulties imposed upon us in attempting to eradicate this disease from such a locality. As an analogy, we all recognize the great care that is necessary in dealing with a similar growth on the ala of the nose where it joins the cheek, with its thin soft tissue layer overlaying cartilage. If we imagine the transfer of this structure to a locality such as the interior of the larynx, and attempt to treat it by a radium applicator not always in correct position and more or less in motion all the time, put in place by indirect vision with not all of the growth in sight, we realize what a difficult problem we have before us in the treatment of laryngeal carcinoma.

Intrinsic laryngeal carcinoma may be roughly divided into two groups of cases, mainly from the standpoint of the ease of spread and the resulting prognosis: (1) Those in which the lesion arises in the anterior portion, where the cartilage affords an adequate barrier against spread through it for a time, and lymphatic drainage is very poor and, (2), those cases in which the growth lies more posteriorly and where lymphatic drainage is quite free, allowing the lesion to spread more readily. Growths in the anterior portion can be regarded as distinctly localized lesions for a comparatively long period, and they should offer excellent opportunities for radiation treatment if this could be applied in an adequate manner. We have observed many such lesions entirely disappear in a very satisfactory manner, only to recur hopelessly. The difficulty lies in our inability to radiate properly the entire involved area, and we are prevented from giving an excessive dose such as might be given elsewhere because of the anatomical characteristics of the laryngeal structures. Subsequent operation in several primarily successful instances has shown an extensive lesion below the cords, part of which was no doubt beyond the range of vision and adequate radiation. The undestroyed por-

*Read at the Ninth Annual Meeting, AMERICAN RADIUM SOCIETY, Chicago, Ill., June 9–10, 1924.

tion below the cords has undoubtedly been the most frequent starting point of recurrence. If our internal radiation dose is too large, we are apt to produce a perichondritis and more or less permanent injury to the cartilage, thus not only tending to break down a natural barrier against spread of the carcinoma, but also making a more favorable field for its spread.

Operative procedures in times gone by have not offered much hope in the cure of laryngeal cancer, but fortunately surgical technique in this line has recently greatly improved and has made possible results not previously obtainable. It may be true that successful operative technique is not an accomplishment of many laryngologists and surgeons, but there is no reason why more and more should not acquire the necessary skill in the near future and relieve radiation therapy of the well nigh hopeless task, that has been thrust upon it because of the lack of better means of dealing with laryngeal cancer.

There are two operative procedures for dealing with the condition—laryngo-fissure and laryngectomy. In early small growths on the more anterior aspect of the cords, laryngo-fissure and excision of the growth down to and including the perichondrium is the operation of choice, and certainly gives better results in skillful hands than radiation. Jackson insists that every portion of the excised tissue be examined to be certain that the excision has been carried wide of the growth.

Postoperative radiation is strongly recommended by some operators, but its efficacy must remain a matter of doubt for the time being, as must much other postoperative radiation. It can certainly do no harm if the dosage is kept within bounds of injuring the cartilage.

In more extensive growths which are not posterior and have not yet become extrinsic, laryngectomy is the procedure indicated. Even in cases with metastatic lymph gland enlargements, comparatively successful results have been obtained. The loss of the voice is one of the great drawbacks to this operation, but much can be accomplished by training of the pharyngeal muscles in the acquisition of talking possibilities. The efficacy of laryngectomy is well illustrated by the following case:

J. M., a male, aged twenty eight. Huskiness of voice for past 14 years. For 16 months has undoubtedly had carcinoma of the larynx. For the past 2 months has been extremely dyspneic, which has forced him to give up work. Examination by Dr. Clerf showed a mass on the left side of the larynx encroaching rapidly on the lumen of the glottis. Tracheotomy advised as a necessary precaution, and performed. Section of growth removed proved to be squamous-cell carcinoma. The patient was carefully and thoroughly treated by internal radium radiation and externally by roentgen radiation. He showed absolutely no improvement one month later, and the growth had become extrinsic. Three weeks later (October 5, 1923) a laryngectomy was performed by Dr. Fielding O. Lewis, and the patient at the present time (8 months later) is in excellent condition, with no evidence of recurrence. He is learning to whisper.

In extensive growths posterior and extrinsic, palliative radiation, *after tracheotomy*, is practically the only procedure to be considered, except tracheotomy alone. Large doses should not be given as they can accomplish no permanent good, and only add to the discomfort of the patient. The attempt should always be made to stop short of cartilage destruction.

We are firmly convinced that a careful biopsy is absolutely essential in every case before any procedure is carried out, and furthermore, that one has no right to claim a cure by radiation for laryngeal cancer unless the claim is backed up by a positive pathological examination. Papillomata may be very extensive and present the clinical picture of carcinoma. These growths call for local surgical removal, and Dr. Jackson is strongly opposed to radiation as it is unsuccessful in ultimately destroying the lesion.

In conclusion, after adequate trial over a period of many years, we have found the results of radiation treatment of laryngeal carcinoma to be very disappointing. We freely acknowledge the superiority of improved surgical technique in operable

cases. Radiation may be employed with care as a palliative measure with tracheotomy in inoperable cases, and possibly as a postoperative measure.

ABSTRACT OF DISCUSSION

PROFESSOR CL. REGAUD, Paris, France. My colleagues and myself have treated 12 cases of carcinoma of the larynx with roentgen radiation alone from 1921 to 1923; 8 of these are clinically well at the present time; 4 resisted treatment; 2 with necrosis of the larynx, 1 was operated upon and 1 died. We have employed the following technique: 2 mm. zinc filter, 45 cm. spark-gap between points, repeating the application every day for three weeks, the total dose being an erythema dose after three weeks, sufficient to cause desquamation. All of these cases were checked by biopsy.

DR. GEORGE E. PFAHLER, Philadelphia. You will recall that two years ago I read a paper on carcinoma of the larynx and at that time I was very enthusiastic about the introduction of radium needles through the thyrohyoid membrane. My prize case has during the past few months developed a recurrence which we have not been able to modify, and I have recommended laryngectomy. Since seeing a case demonstrated by Dr. Fielding O. Lewis in which he had performed a laryngectomy for cancer, and the patient addressed the County Medical Society in Philadelphia and could be plainly heard, I have become, like Dr. Pancoast, a convert to surgery.

INDICATIONS FOR RADIUM AND OTHER METHODS OF TREATMENT IN CANCER*

BY WILLIAM H. SCHMIDT, M.D.

PHILADELPHIA, PENNSYLVANIA

THE ideal treatment of cancer requires not only a thorough study of each individual case, but also intimate knowledge of the various means which are of accepted value in this disease. Many men allow themselves to become faddists with certain methods, and attempt to make the the case suit the method instead of selecting the method for the particular case. In this way, many cases are treated by their favorite method to the disadvantage of the patient, when some other form of treatment would prove far more satisfactory both to the patient and the physician. It is essential, therefore, that our cases should be studied more systematically, and it is the duty of the physician to be familiar with every form of treatment of value in this disease. It is admitted that experience with a certain form of treatment increases proficiency, and one man may obtain brilliant results where another would fail, but there are definite factors which indicate one method to the exclusion of others in certain cases.

In every case, there are three things which require careful consideration: First, the patient; second, the tumor, and third, the means by which we can best eradicate the tumor and restore the patient to health.

1. *The Patient.* It would seem that in the past, we have been too prone to think only of the disease and to give scant consideration to the patient. This is a great mistake which I think the profession is beginning to realize. Every patient should receive a thorough physical examination before treatment is decided upon. This is important, as it frequently brings to light essential facts which often have a bearing on the management of the case. A careful history, both family and personal, with a clinical history of the growth is very important, in order that we may properly evaluate the patient's ability to withstand the disease and the additional toxemia due to treatment. A careful investigation of the heart and lungs should be made to determine possible degenerative changes. A complete examination of the blood should be made to determine to what extent the blood has been damaged, and of the urine to determine the defects of elimination. A careful search must be made for any possible metastasis, including roentgen-ray examination of any suspected area, such as the chest or bones. Lastly,

* Read at the Ninth Annual Meeting, AMERICAN RADIUM SOCIETY, Chicago, Ill., June 9–10, 1924.

and very important, the disposition and nervous stability of the patient must be given due consideration, because an unstable nervous system will easily break under the strain of prolonged treatment, with its suffering and frequent disappointments. The importance of this factor is frequently overlooked. The patient should be encouraged as much as possible, and kept in a cheerful and hopeful frame of mind. If the patient is in good physical condition, we can attack the disease much more vigorously and with more potent weapons, and with greater hope of success than we can in one who is cachectic, with a poor blood picture and an unstable nervous system. In the latter case, we must proceed with more caution and not flood the system with a large supply of toxin from a devitalized tumor. Unfortunately, the treatment in many of these cases is prolonged and the drain on the physical side combined with the mental strain often proves disastrous, even to a patient in fairly good physical condition. The prime object in every case should be to conserve the patient's strength as much as possible, and avoid every unnecessary drain on the vitality. Every case would be better off if the physical condition were constantly under the observation of a trained physician while under treatment, and every effort should be made to increase the patient's resistance and general health. There can be no question but that there are certain factors in the body itself, call it immunity or what you will, which tend to overcome the malignant process, and the effects of our efforts are simply to aid nature by devitalizing the neoplastic cells or destroying a certain number, so that nature can overcome the remainder and thus eradicate the disease.

Loss of blood is another thing that must be carefully guarded against, as we frequently see the tide turn against the patient after a sudden hemorrhage, or continued small losses of blood. In any condition, where a hemorrhage is threatened, it should be forestalled by ligation of the main blood supply. This will not only aid in preventing the loss of blood, but by cutting off the blood supply to the growth, its nutrition is diminished. This is particularly important in mouth cases where the difficulties of feeding are an added handicap to the patient.

FIG. 1*a*. Two epitheliomas, one on the temple, the other on the cheek. Epithelioma on the cheek shows marked infiltration of the cheek. Radium is indicated in this case.

FIG. 1*b*. Patient with radium needles in place, showing threads by which the needles are withdrawn.

2. *The Tumor.* For a long time, it has been evident that there is a vast difference in the way in which tumors respond to treatment. This is particularly true as regards the response to radiation. One tumor will respond readily to treatment and disappear, while an apparently similar

growth will be very resistant. For some time, we have been able to tell exactly how certain tumors, such as lymphoma will respond, but it was not until we began to make an extensive pathological study of our cases that the exact reason for this behavior in other neoplasms became manifest. Tumors, which to all appearances were grossly alike, were found on microscopic study to be composed of cells in widely different stages of differentiation. It soon became apparent that the tumor composed of embryonic cells was much more vulnerable and succumbed to a much smaller dose of radiation than the tumor composed of cells which have differentiated to a greater degree and taken on more of an adult type. We all realize that the value of radiation in cancer is not so much its selective action as the vulnerability of the cancer cell as compared to the normal adult cell. We are thus able to plan our dosage so as to devitalize the abnormal cell, while the normal cell will recover. It is readily apparent, therefore, that the greater the difference, the more effective will be our radiation. As we approach the adult type, the amount of radiation must be increased until we reach the stage where nothing short of actual destruction will be of any use. In this event, radiation has reached the stage where the normal adjacent tissue is affected nearly as much as the malignant tissue, and an undesirable condition exists. Nature is waging a fight against the neoplasm, and if the normal surrounding tissue is devitalized, we are losing the aid of this valuable assistance in overcoming the disease. If, therefore, an agent which will produce destruction of malignant tissue without injuring the normal is available, it is by far to be preferred. There are other forms of tumors which are very resistant to radiation, and whose nature it is important to know before deciding on treatment. We must know not only the histologic elements of a tumor, but the maturity of its cells, in order appropriately to treat the case. With increased knowledge and study, we will undoubtedly soon be able to classify our neoplasms and be far more accurate in our treatment and prognosis. Another important point is that incomplete treatment is probably worse than none at all, as the remaining tissue having the advantage of an increased blood supply takes on an active growth, and the rapidly multiplying cells are no longer adult in type, but of a malignant undifferentiated type. This is not true so much with radiation therapy as it is after the use of surgery or the electrothermic method.

FIG. 1c. Roentgenogram of skull showing arrangement of needles to obtain crossfire radiation of entire growth.

FIG. 1d. Shows healing and the entire disappearance of the disease.

3. *The Remedy*. The cancer victim will do best who is fortunate enough to select a

physician who, in addition to medical skill, possesses the ability to select the remedy best suited to the individual tumor, surgery, radium, roentgen radiation and the electrothermic method. It is impossible to say which of these is foremost, as each

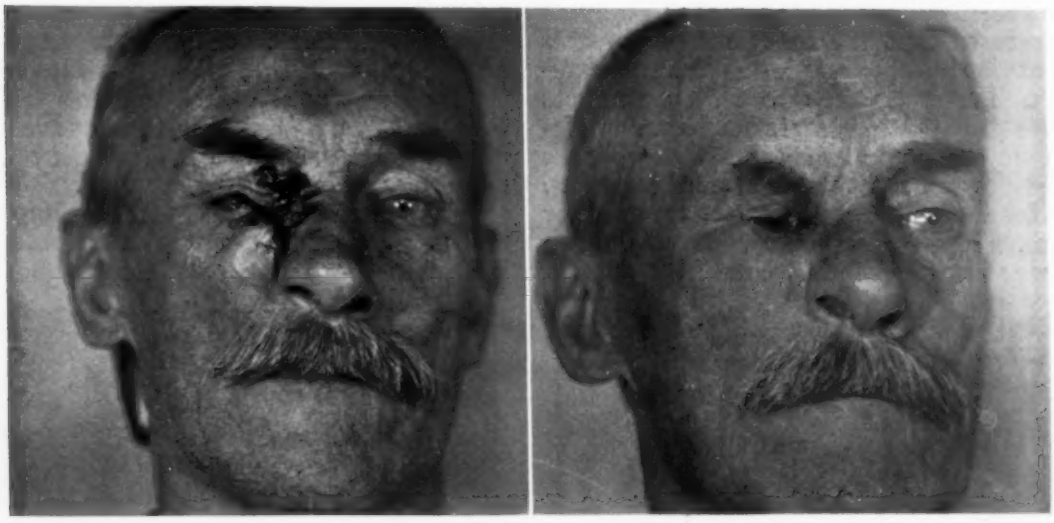


FIG. 2*a*. Advanced epithelioma involving the nose, upper and lower lids and orbit. Electrothermic method indicated, with enucleation of the eye ball.

FIG. 2*b*. Results after healing.

and whose knowledge of all methods is such that he can employ them in combination where they are indicated.

has its own special indication and use, and frequently one must be made to supplement the other.

FIG. 3*a*. Large, rapidly growing epithelioma of the face. Growth more or less pedunculated. Desiccation method indicated.

FIG. 3*b*. Result of treatment.

In addition to careful attention to the patient's physical condition, we possess four means of attacking cancer. They are

Surgery was the method of choice for years, and has by no means been supplanted by the newer methods. Unfortunately,

some surgeons have come to look upon the newer methods as rivals of surgery. This may be true in a few instances, such as cancer of the cervix, but the surgeon must realize that these newer agents are not rivals, but the greatest aid to successful surgery.

Surgery still has its field in many internal and inaccessible growths, especially in the gastrointestinal tract. It is also necessary to expose certain neoplasms, so that they may be more effectually treated by one of the other agents, as in cancer of the bladder and prostate. Frequently, it is advisable to remove surgically the gross mass, preceded and followed by suitable radiation therapy, as in certain cases of cancer of the breast. In other cases, as in cancer of the rectum, it is wise to perform a preliminary colostomy, so that the lower bowel may be placed at rest, or to perform a gastrostomy that a bad mouth or esophageal case may be properly nourished during treatment. Certain defects resulting from treatment must be repaired as in advanced cancer of the lip or cheek. Surgery is primarily indicated in certain other growths as osteosarcoma, myxomatous tumors in the parotid region, removal of malignant glands after radiation, and many other tumors in locations that are intimately associated with important structures. Growths which are so located that radiation would damage important structures in close proximity, such as the adrenals and pancreas, are better treated surgically. Cancer of the body of the uterus is probably also best treated surgically. Surgery has not therefore been replaced, but has its important uses, and when combined with one or more of the other methods, its use is very greatly extended.

Radium. The value of radium has long since been recognized in the treatment of cancer, but it is also evident that a diagnosis of cancer is not the indication for radium. The pathological study of the individual cell is far more important, and the more embryonal in type the cells are, the more effective our radium treatment will be, and the more accurate a prognosis can be made. As the cells differentiate and approach the adult type, radium is less effective, and the time element must be increased until we reach a stage where nothing short of a caustic action is of any use. At this point, radium ceases to be the ideal remedy, as the normal tissue must also suffer.

Radium is the method of choice in cancer of the cervix, and results, even in advanced cases, justify its selection over any other method. Here again, we are helped by our

FIG. 4*a*. Basal cell epithelioma of lower eyelid. Desiccation method indicated.

FIG. 4*b*. Result of treatment.

knowledge of the pathology of the tumor so that the time factor can be properly regulated.

FIG. 5a. Advanced epithelioma involving upper and lower lid, nose, cheek and tissue of the orbit. Growth destroyed by electrothermic method. Eye ball enucleated.

FIG. 5b. Result of treatment.

All tumors of lymphatic tissue, if they are accessible, are amenable and respond regularly. In metastasis to lymph glands, buried radium element, in my experience, is preferred, followed with external applications of radium or roentgen rays. If it is thought advisable to remove the glands surgically, it should be done only after thorough radiation.

Cancer in close proximity to large vessels and nerves should be treated with radium. In carcinoma of the breast, radium element buried in the mass greatly aids the effects of roentgen radiation, and hastens the destruction of the growth. In this event,

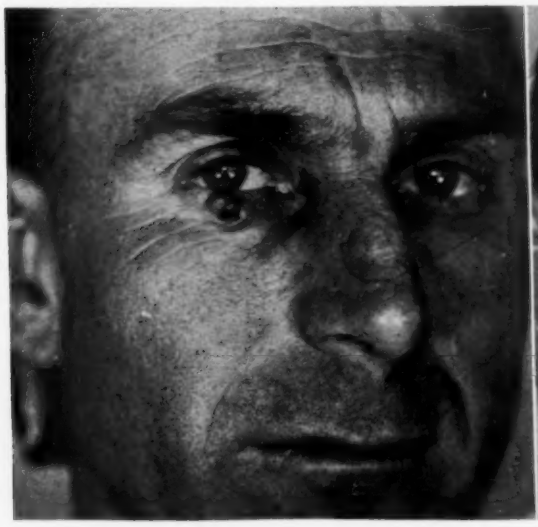


FIG. 6a. Basal cell epithelioma of lower eyelid involving the margin. Desiccation method indicated.

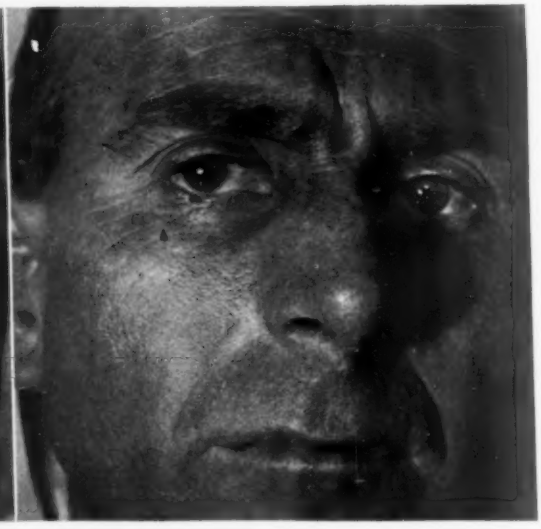


FIG. 6b. Result of treatment by desiccation method.

roentgen radiation should always be used in combination with radium, as its effective radiation does not extend far enough to take care of metastases in the lymphatics of the mediastinum and axilla. Radium is also indicated in cancer of the prostate and bladder after surgical exposure by the suprapubic method. One of the most effective uses of radium is in recurrent glioma of the orbit. This tissue is very susceptible to radium, and the use of buried element in needles will cause a complete disappearance of the local lesion.

Roentgen radiation should be employed particularly when we wish to obtain a widespread effect of our radiation in contradistinction to radium where the effects are concentrated; also where the lesion is situated at a distance from the skin. Its greatest use is probably as an adjunct to other treatment. Many cases of breast cancer can be successfully treated with roentgen radiation alone. The operator must be perfectly familiar with his own apparatus, and know exactly the amount and quality of radiation his machine will

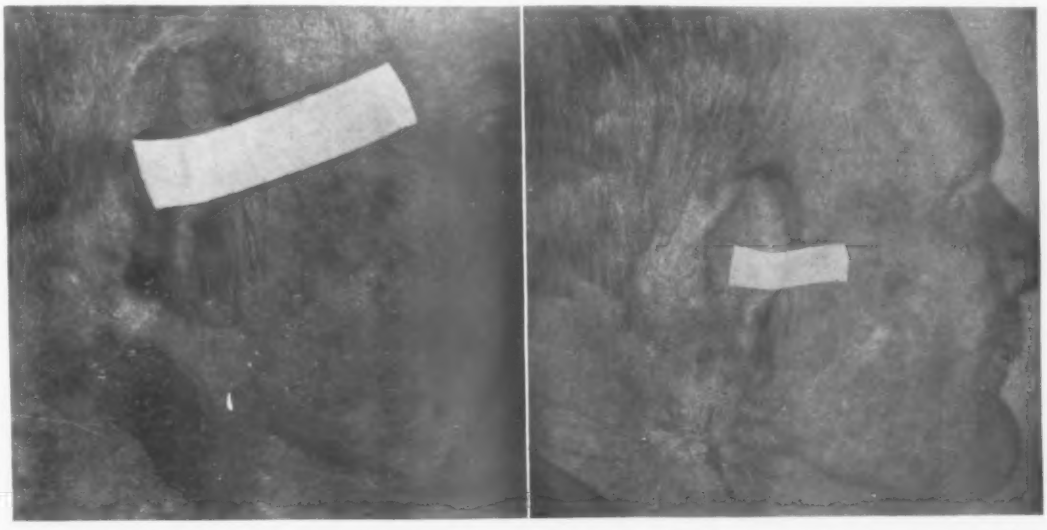


FIG. 7*a*. Basal cell epithelioma on neck, posterior to ear. Electrothermic method indicated.

FIG. 7*b*. Result of treatment by electrothermic method.

Cancer of the tonsil is best treated with buried radium element followed by external radiation to the glands. The time element must be carefully regulated to prevent undue destruction or sloughing, as this frequently proves a difficult situation to handle. Cancer of the larynx and vocal cords can also be treated by radium. It is usually necessary to use buried element in needles containing from 1 to 3 mg. of radium, and carefully regulate the time.

There are also special indications for the use of radium. Regardless of location, we may employ it to conserve tissue where this is an important factor as in certain advanced cancers of the lip, or where the entire cheek is infiltrated; also in recurrent nodules after operation for cancer of the breast.

deliver. Careful calculation of the dose necessary, with good judgment in selecting the skin area and direction of the dose is most important. Modern deep therapy has greatly extended the usefulness of roentgen rays in enabling us to deliver a greater depth dose, and has brought within range of treatment many deep-seated neoplasms, and greatly increased the effectiveness in lesions in which our former methods were only partially successful. The tendency seems to be to divide the dose, giving consideration to the patient as well as to the disease, a point which I feel has not been true with the original massive dose deep therapy.

Malignant glands should receive roentgen radiation either with or without the aid of buried radium element, depending upon

conditions. The glandular area in cancer of the cervix, rectum, bladder and prostate must also receive deep roentgen therapy.

FIG. 8a. Basal cell epithelioma of the nose. Desiccation method indicated.

FIG. 8b. Result of one desiccation treatment. Perfect healing.

Any deep-seated and inaccessible growth which is not associated with vital glandular structure, such as the adrenal and pancreas, should be treated with deep penetrating roentgen radiation. Metastasis to the lungs and bones yields most readily to roentgen therapy. Sarcoma, because of its large size and rapid metastasis is best treated with roentgen radiation, and depending, of course, upon its type, usually responds very well. Unfortunately, metastasis is

FIG. 9a. Advanced carcinoma of the breast; showing marked infiltration of entire breast, deep ulceration in upper portion. Involvement of two ribs. Treated with radium element in needles followed by roentgen radiation. Entire neoplasm devitalized.

FIG. 9b. Devitalized breast removed by the electrothermic method. Results after slough had separated showing two ribs which were diseased, exposed.

usually widespread, and our local success is frequently nullified by the dissemination of the disease by the blood.

Electrothermic Method. It is most unfortunate that so many men doing cancer work are unfamiliar with, or have only a superficial knowledge of this important method. It is very effective in certain types of growth and in certain locations.

In the author's experience, practically every case of basal cell epithelioma of the face and extremities is treated by the electrothermic method as a matter of choice. Under local anesthesia, the growth is destroyed at once and curetted away. There is no pain, and as the normal tissue is not devitalized, healing takes place rapidly. Recurrence or failure to destroy all malignant tissue, though rare, is readily apparent in a week or ten days, and such recurrences can readily be destroyed by a second application. Even extensive growths involving the nose, face or orbit can be entirely eradicated if we destroy all the malignant tissue. The treatment is not prolonged and healing is always rapid.

With few exceptions, cancer of the lower lip is destroyed by the electrothermic method, followed with radium to the lymphatic area and glands of the neck. In the mouth, the author feels that the electrothermic method is superior to all others. In cancer of the tongue, cheeks, aveolus, upper jaw and antrum, nothing else accomplishes the work so well. Except in cancer of the tonsil, and occasionally in cancer of the floor of the mouth, radium is seldom, if ever used. The majority of growths in the mouth are of such pathological structure and the cells so well differentiated that nothing short of actual destructive action is of any use, and to produce the result with radium, a large dose must be applied.

FIG. 9c. Shows rapid healing by granulation after removal of ribs. No evidence of disease at this time. Axilla treated by deep roentgen therapy.

Surface application of radium is difficult and may be dangerous, as this frequently heals over a malignant area, leaving disease in the depths. Buried radium is the only course justified, and to this there are serious objections. The reaction is very severe and the pain lasts for weeks, and this of itself will wear out a patient. Indolent sloughs result, and it requires weeks for the slough to separate, this interfering seriously with nutrition. The resulting scar is hard, and it is impossible to tell whether all disease is destroyed or not.

Of course, it is apparent that one who is master of a procedure will obtain better results than the average, and therefore some men obtain good results in month

cases with radium; but by the electrothermic method we can absolutely destroy all disease without devitalizing the normal tissue. There is no severe pain following the treatment, the slough separates in a week or so, and we can tell immediately whether or not the neoplasm is entirely destroyed. Blood or lymphatic spaces are not opened and there is no danger of spreading the disease. Bone can be destroyed as readily as flesh and this will sequestrate in about six weeks or more, while bone devitalized by radium usually has to be removed surgically. Healing is rapid with a soft pliable scar, and the only complication to be feared is hemorrhage, but this is unusual, and can always be guarded against by proper ligation of the main blood supply. This complication is most likely to be found in cases showing a high blood pressure or marked sclerosis of the arteries.

The use of the electrothermic method in mouth cases has many desirable advantages, and with a little experience one can become proficient and obtain good results with less inconvenience and suffering to the patient. Of course this treatment is only for the local lesion. The glands when involved must be treated by radium and roentgen radiation and our ultimate results must depend upon our success or failure with the glandular metastasis.

If it is the operator's desire to obtain the cross-fire effect of radium from the mouth, the local lesion may be treated with radium, and destroyed about a week later by the electrothermic method, thus avoiding the radium reaction.

Another important use for the electrothermic method is the destruction of indolent slough resulting from radium which persists and shows slight tendency to clear up. The devitalized tissue with its indolent base is destroyed and curetted away and a healthy granulation takes place. In the same way an ulcerated roentgen burn, if not too large, can be similarly treated.

FIG. 10a. Rapidly growing epithelioma. Cells embryonal in type. Entire cheek to the mucous membrane infiltrated. Radium indicated.

FIG. 10b. Result of treatment with radium element in needles. No recurrence after five years.

Combined Treatment. While there are indications for the choice of one method as the principal factor in each case, it is very rare that the results cannot be improved by the use of two or more methods in a given case. A thorough knowledge of all four is essential, if we hope to give the patient the best of all modern treatment, and it behooves every physician doing this work to become familiar with all. The physician who tries to treat cancer with one method alone is only half equipped, and can not expect to obtain the results he would if familiar with every means of treating cancer.

To mention just a few instances, we may take cancer of the mouth or lower lip.

Here, the primary factor is destruction of the local lesion with the electrothermic method, to be followed by radium, or roentgen radiation to the glandular area with the occasional use of surgery for ligation or plastic repair. Cancer of the uterus, rectum and prostate should be primarily treated with radium, and assisted by the external use of roentgen radiation, and occasionally surgery for exposure or colostomy. It is important, therefore, that one form of treatment be made to assist another, and in that way, we will get our patients well quickly and with less discomfort.

In conclusion, I wish to emphasize, (1) the importance of a thorough knowledge of the physical condition of the patient, so that consideration may be given the patient as well as the disease.

(2) Detailed pathological study of the tumor so that we may know what we are treating, and how it will respond to the various agencies.

(3) A thorough knowledge of the various means of treating the disease, so that we may know their value and indication. A proper selection of the method best suited to the case as the primary means of attacking the disease.

(4) The use of combined methods utilizing one to supplement the other, thus eradicating the disease more thoroughly and permanently with less damage to the general physical condition of the patient. It is only in this way that we can do full justice to the patient, and have the satisfaction of seeing many otherwise hopeless cases restored to health.

ABSTRACT OF DISCUSSION

Dr. John M. Lee, Rochester, N. Y. I would criticize the procedure of removal of specimens for biopsy by the knife. The use of the cautery or endothermy, especially if desiccation is employed, seems much safer. Excision of specimens by the scalpel promotes considerable hemorrhage, and ligation may be required. I have seen metastasis result from such a procedure.

Dr. Henry Schmitz, Chicago. I wish to refer particularly to that portion of Dr. Schmidt's paper in which he speaks of the great vulnerability of the embryonal cancer cell in comparison with that of the adult cell. This subject was discussed last year in connection with the erythema dose method, and it was stated that the embryonal cancer cell would easily degenerate after an erythema skin dose while the adult cell would not. The combination of surgery with radium and roentgen radiation in carcinoma of the cervix is entirely out of the question. Entirely different conditions are present here than elsewhere. We can cause absolute destruction of the uterine cancer by radiation and surgery is not required.

Dr. Ernest C. Samuel, New Orleans, La. I would like to ask Dr. Schmidt the average length of time that has elapsed since the treatment of the cases he has reported. We should do away with the custom of reporting before a body like this any series of cases that have not passed at least the three year period, and preferably five. Reporting cases for the sake of showing immediate results only creates a very bad impression.

Dr. Henry K. Pancoast, Philadelphia. I wish to agree most heartily with Dr. Samuel's remarks. We are entirely too prone to report immediate results, and we are being justly criticized for so doing. The final proof of the value of non-surgical measures will be the length of time the patient lives, and not the immediate result. At the present time, pathological confirmation of clinical diagnoses of malignancies is absolutely necessary. The specimen, with few exceptions, can be removed with safety by the knife. Where this is not safe or feasible, electro-desiccation may be employed instead. We should use our judgment as to which method is best suited to the individual case. These remarks do not, of course, apply to such conditions as cancer of the breast. The Cancer Commission of the American College of Surgeons is now making comparative investigations of results by surgical and non-surgical methods, and to be included in the groups, every case must be proven. Recently many reports of supposed cancer of the cervix treated by radiation had to be excluded because of lack of proof of the condition by biopsy. The surgeon has the advantage of always having the specimen for examination. Be sure to secure specimens from all of your mouth and lip cases in the future.

Dr. George E. Pfahler, Philadelphia. I believe that wherever practicable we should remove a section for microscopic study, but this is not practicable in all cases, and especially in the breast, where it will usually be meddlesome. I do not oppose the principle of scientific accuracy, but let us be careful and not meddlesome.

As to the application of electrodesiccation or diathermy, we have a large field for this in removing grossly malignant disease wherever this can be done without serious injury to essential organs or important blood vessels or nerves.

DR. SCHMIDT, (closing). In reference to taking sections for pathological study, we use electrothermic methods as a rule. It is easy and usually safe to remove a section with the knife if we immediately destroy the area by electrothermic means. The cases I have shown and reported were intended to represent types treated rather than cases cured. Most of them have gone over the three year period, however, except the ones mentioned. In cancer of the uterus, we agree with Dr. Schmitz that there is no necessity for anything but radiation therapy, which takes care of all the disease.

CANCEROUS ULCERS OF THE STOMACH PRODUCING ONLY REFLEX "DUODENAL" DERANGEMENTS SHOWN BY ROENTGENOGRAMS*

BY A. GALAMBOS, M.D.

NEW YORK CITY

IT is a well-known fact, that various organic diseases can easily provoke secondary reflex disturbances in the gastric function. These functional disorders may be sensory, secretory or motor in character. In the last group, which surpasses the others in importance, the motor disturbances can easily be visualized and studied before the roentgen-ray screen. Duodenal ulcer, cholelithiasis, appendicitis, nephrolithiasis, genital affections, tabes, even neurasthenia and hysteria are often associated with secondary gastric symptoms. Alterations in the gastric tonus, peristalsis, motility and also spasms, hour-glass formation, etc., must therefore be very carefully interpreted and evaluated. They may in some instances represent true gastric diseases, while in others they are concomitant manifestations of various diseases, without actual participation of the stomach. These secondary changes are observed only in the stomach, not in the duodenum or in other organs.

Duodenal ulcer may produce spastic hour-glass formation over the stomach (Baron and Barsony), also reflex spastic contractions of the esophagus (Assmann), but the reverse type, i.e., secondary, spastic symptoms over the duodenum in cases of ulcer or cancer of the stomach, were not observed.

There are but few cases known in which functional disturbances were observed over the duodenum, and neither the operation nor the autopsy revealed the presence of duodenal organic affection; Assmann observed in one case of neurosis ventriculi an hour-glass deformity of the duodenum and in another case a persistent bulbus with hour-glass formation of the duodenum, in which the operation revealed a normal duodenum but there were firm adhesions around the site of the appendix, which had been removed years ago. Carman observed among a large number of cases only 3 instances of bulbar deformity without ulcer of the duodenum, once with the primary disease of the pancreas, and twice with that of the gallbladder. So far as I was able to discover, I could not find any author who had observed gastric ulcer or cancer cases with the concomitant derangements and with only manifestations over the duodenum, as shown by the roentgenograms.

The case which is here reported deserves attention for several reasons, but mainly because, in my opinion, it is the first case, in which gastric disease, such as ulcus carcinomatosum has been observed to produce secondary changes in the function of the duodenum, in a characteristic way. While these secondary changes were very marked, in fact, quite pronounced, and offer the symptom-complex of an organic duodenal disease, the stomach, which was the primary seat of the cancerous ulcer, did not manifest any direct sign of this disease; even most of the secondary signs seemed to have had their origin in an affection of the duodenum.

*Read before the German Medical Society, New York City, June 2, 1924.

CASE REPORT

S. J., male, aged forty-five, about six or seven months ago developed an illness of slow onset, with loss of appetite, weight and strength. Vomiting began 2 or 3 months ago, and recently became more frequent and massive. Later it occurred 2 or 3 times daily, at 2 or 3 day intervals. It resulted in complete evacuation of the stomach which made the patient more comfortable for a time. The vomit contained foodstuffs taken 1 or 2 days previously. It was never bloody, but on one occasion it was supposed to be of coffee-ground character. Since the onset of his illness the patient has been constipated, but the feces have not been tarry. It must be emphasized, however, that the patient, throughout his illness, never had any pains, nor even digestive distress, such as heart-burn or sour eructations, and also that before his present ailment he was always healthy and never had any stomach trouble.

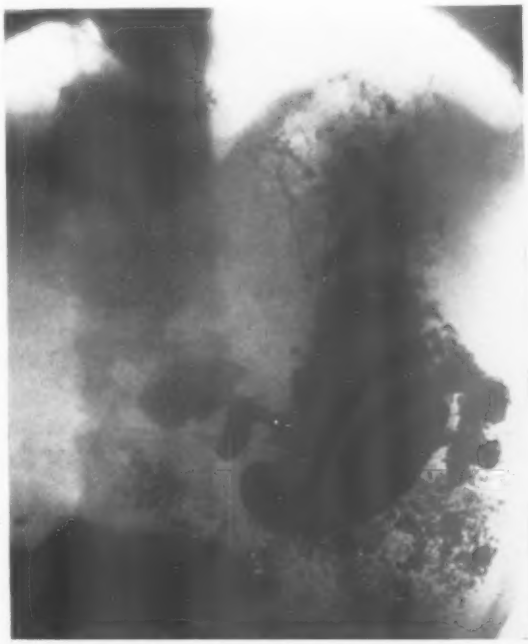


FIG. 1. Shows hour-glass bulbus. Circumscribed, pea-sized spastic contraction in the aboral part of the duodenum, major curvature side.

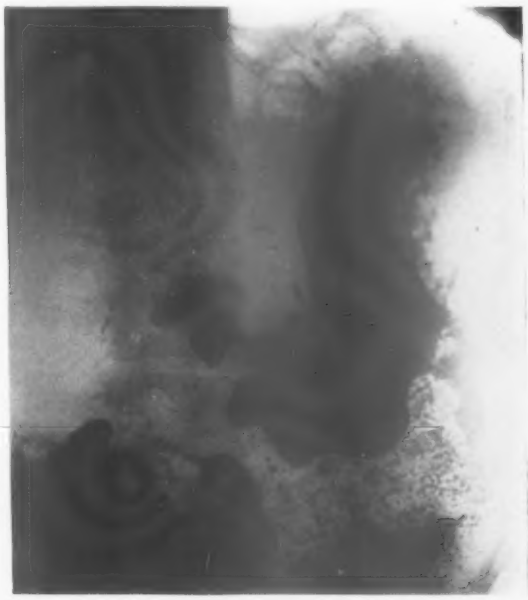


FIG. 2. Shows hour-glass bulbus and hyperperistaltic stomach.

Objective examination yielded entirely negative findings. The man was noticeably emaciated but not cachectic. The chest organs were normal. All parts of the abdominal wall were equally rigid. Deep palpation was not feasible. Deep pressure or tapping with a percussion hammer over the epigastrium, as well as all over the abdomen, did not elicit even the slightest pain or tenderness. No Boas' point was found. There was no skin hyperesthesia present, no tumor, and no regional nor Virchow's glands were palpable.

The stool gave a slightly positive reaction for occult blood. In the fasting stomach after vomiting during the preceding night about 20 c.c. of almost clear gastric juice containing mucous shreds and free hydrochloric acid was found. Macroscopic remnants of foodstuffs were not seen. Microscopic examination revealed microstagnation; no bacteria were present. Examination repeated on the following day, gave—though no vomiting had occurred during the preceding twenty-four hours—from the fasting stomach about 120 c.c. slightly greenish, clear, gastric juice, which contained free HCl (HCl = 30, total acidity = 45). Subsequent lavage did not reveal any residual content. As regards motor power and secretion, satisfactory information could be obtained from both of these examinations on the

fasting stomach; no test-meals were administered.

Roentgen-ray examination gave the following results: The stomach, entirely filled with the barium emulsion showed hypertonus, hyperperistalsis and hypermotility. The motility was so highly exaggerated that the greater part of the barium left the stomach in the course of about 20 or 25 minutes. Later on pylorospasm set in (Kreutzfuchs' tardivpylorospasm). It seems to be very probable that the typical form of the spastic pyloric stenosis—which was observable at that time—was at least partly through the tardivbulbospasm produced in the sense of the explanation of Åkerlund, and not through true pylorospasm. The greater curvature showed marked indentation. The lesser curvature was smooth, round and sharply delineated throughout its extent. There was visible a constantly abnormal filling of the duodenum. While the barium was in the bulbus and in the descending part of the duodenum, hypermotility could be observed, the lower horizontal portion, which seemed to be rather relaxed and dilated, showed a more constant filling, i.e., a lessened motility. The configuration of the deformed bulbus duodeni was not constantly uniform, changes pointing to the possibility of spastic components bringing on this shifting of the distortion. The cap was never filled out, nor well rounded. Outside of the marked deformity and shifting of the filling defect, there was bilateral spastic contraction—incisura—present giving an hour-glass formation of the bulbus duodeni. Also sharply outlined, rounded, pea-sized bulbus defects were visible in the greater curvature side of the duodenum in a rather shifting localization. These defects, which in Åkerlund's explanation respond to the spastic contraction of the muscularis mucosae, were to be seen in some pictures in the oral and in others in the aboral portion of the bulbus. The outflow of the barium into and through the duodenum occurred in a copious stream, which resulted in very rapid filling of the jejunum. Refilling the stomach with the same barium mixture revealed entirely different conditions. Instead of the hypermotility, lessened motility set in, with more than 24 hours' retention of the barium in

FIG. 3. Shows incomplete hour-glass formation of the bulbus duodeni and spastic contraction in the oral portion of the bulbus.

FIG. 4. Duodenal muscle syndrome.

the stomach, characterized by the typical picture of spastic pyloric stenosis, in which the possible rôle of spastic bulbar stenosis could not entirely be disregarded especially as the duodenum showed even a more pronounced picture than before, with the most remarkable hour-glass-like, spastic, double-sided incisura.

The patient's age, the short duration of the illness and the insidious, slow onset of the disease in a man, who had never before had any gastric trouble, the painless course, the massive vomiting, the motor insufficiency in form of pyloric stenosis, with subsequent emaciation, with lack of epigastric tenderness were signs strongly indicative of gastric cancer. On the other hand, the lack of cachexia, shifting motility, hypersecretion and presence of free HCl were signs opposing a diagnosis of cancer and favoring one of gastric ulcer. The roentgen findings were characteristic of some duodenal lesion. Because of the motor insufficiency and a possible malignancy of the lesion, operation was decided upon. The patient was admitted to the Lenox Hill Hospital to the service of Dr. T. De W. Stetten and the operation was performed by Dr. J. Gerster. On exposing the stomach two callous gastric ulcers of the lesser curvature were discovered. No duodenal involvement whatsoever could be detected. The ulcers were located in the stomach road (Aschoff) in the lower third of the lesser curvature. The procedure employed was gastric resection with gastro-entero-anastomosis. The pathological findings were as follows:

Gross Appearance. The specimen consists of the pylorus and pyloric portion of the stomach. It measures 3 cm. in length, 5 cm. in circumference at the pylorus and 9 cm. in circumference at the superior end. The outer surface is smooth and glistening. The inner surface has a papulated appearance. There is an ulcer at the pyloric sphincter, the base of which measures 0.5 cm. in diameter, and another situated at the lesser curvature, the base measuring 1 cm. in diameter. The margins of both are raised and reddened and partially overhanging and everted. The wall at the site of the pyloric ulcer measures 4 mm. in thickness, while that of the other gastric ulcer measures 9 mm. and is slightly indurated.

Microscopic Examination. Section of one of the ulcers shows an adenocarcinoma, involving the edges of the ulcer and a part of the ulcer floor. The growth is generally superficial, the greater part being confined to the mucosa and submucosa; in areas, however, there are isolated groups of tumor acini in the muscularis. The tumor cells are arranged in acini, islands or narrow columns. The acinar cells are generally cylindric in shape and are a single row thick. The stroma is fairly abundant and shows areas of mucinous degeneration and small round-cell infiltration. The deepest part of the ulcer floor reaches to the superficial part of the muscularis. Section of the other ulcer shows the ulcer floor to be formed by sclerotic submucosa and the superficial part of the muscularis. The floor shows superficial necrosis and is infiltrated with inflammatory cells. The mucous membrane at one edge shows definite carcinomatous changes, some of the acini being converted into solid strands, columns or islands of hyperchromatic, polyhedral or cuboidal cells. A few of these structures infiltrate the submucosa. The base of the ulcer is apparently free from any involvement.

Diagnosis. Multiple carcinomata of the stomach, secondary to chronic, gastric ulcers.

Cancerous degeneration of ulcers in an early stage is a microscopical diagnosis. The clinical and roentgen-ray findings are those usually present when the cancerous degeneration is not far advanced, i.e., the ulcer is small in size, and gives the syndrome of an ulcer and not of a cancer. This was the case with our patient; the cancerous degeneration was recognizable only in the microscopic findings; even the excised ulcer did not show the macroscopic appearance of a cancerous degeneration.

A conspicuous feature in this case was that our patient never had any pains in the stomach and there was not the slightest tenderness over the abdomen. Pains, showing a definite periodicity, concomitant subjective complaints, circumscribed tenderness over the epigastrium or over the ulcerous area are the most characteristic and also the most striking signs of an ulcer. Lack of all these symptoms may make the diagnosis very difficult.

Gastric ulcer belongs to the constitutional diseases; the basis on which it develops is a constitutional inferiority. As the majority of the gastric ulcer patients are recruited from the neurotics, pains and distress are often attributed to the presence of the neurotic disposition. When gastric ulcer develops, as it seldom does, however, in a person without any constitutional derangements or in one with a constitutional inferiority, but in whom no excitoneurotic, but rather depressoneurotic symptoms are predominant, there may be present, contrary to the findings of most cases, in which hyperesthesia and hypersensitiveness are the characteristics, hyposensitiveness or anesthesia, just as in some forms of hysteria, characterized by anesthesia or analgesia of some particular part of the skin or mucous membranes.

It is quite important that we recognize the possibility of development of an anatommical lesion in a person with constitutional shortcomings, manifested by the presence of a depressoneurotic symptom-complex, as it may explain the development of ulcer, cancer, perforation hematemesis, etc., in individuals who had never had any gastric trouble, and explain cases in which e.g., a man, who had previously never had any stomach complaints, suddenly bled to death from a gastric ulcer, as found by autopsy. Anesthesia or hyposensitiveness is therefore a very important form of gastric neurosis which was recognized and accordingly classified among the other well-known forms of gastric neurosis by the author of this paper.

Our patient had a primary ulcer of callous, chronic type. The duration of the ulcer cannot be stated, as it developed in a hyposensitive man, without causing any pains or distress, but it may date back many years. The cancerous degeneration, which might have been of short duration, was a secondary involvement. The patient's attention was called to his sickness only after motor insufficiency and emaciation set in, and these symptoms may coincide in time with the secondary degeneration of the ulcer.

The motor insufficiency and vomiting deserve some interpretation. First, the emesis seemed to be due to pyloric obstruction, but operation revealed that such a lesion was not present. The motor power was at times, as shown by the functional examination on fasting stomach, quite satisfactory, on other occasions it was highly exaggerated, as proved by the first barium meal and again impairment of the motility was present which hindered evacuation of the viscus, as shown by the vomiting and also by the second roentgen examination. The intermittency and shifting in the motor power could not be explained by an organic pyloric obstruction, but it must be ascribed to neurotic components, in all probability spastic contractions, as a temporary accompaniment of the ulcer of the lesser curvature. The spasms were partly referable to the pylorospasm, partly as it could convincingly be demonstrated to bulbospasm. Shifting and intermittency of the motor function are alone sufficient reason for the assumption of the coexistence of functional factors. The unquestionably high degree of hypermotility, which was present at times, as well as the shifting of an important and characteristic function, such as the motor power, are phenomena not common in gastric ulcers, they are more frequently met with in cases of duodenal ulcer.

Still greater significance and importance must be attributed to the roentgen-ray findings. As is well known, gastric ulcers may have direct and indirect or secondary signs in the roentgenologic picture. The direct signs usually are missed only in the superficial mucous abrasions, while in chronic cases, with indurated ulcers, a niche, accessory pocket, or hour-glass formation is a routine finding. In the case under consideration, though the ulcer was chronic, callous and indurated, no direct sign whatsoever was present. Roentgenoscopy revealed an undisturbed, concave, smooth lesser curvature, as did also the roentgenograms. In some of the plates, a slightly suspicious projection in the lower third of the lesser curvature was visible, in other roentgenograms it was missing entirely, while in still others it showed a shifting form, and it seemed rather to be a bulge between two hyperperistaltic contraction waves.

The secondary or indirect signs of the gastric ulcer manifested in the stomach

are less constant and less significant than the direct signs. Tonus and peristalsis are usually increased, while the motility is often lessened. Cancerous involvement may bring on hypermotility in case of carcinoma distant from the pylorus. The classical triad of "hypers" associated with hypersecretion is something quite characteristic of duodenal ulcer, especially when the hypermotility is later followed by a subsequent hypomotility; so it is understandable, that the hyperperistalsis alone which, according to Carman, occurs in about 60 per cent of all duodenal ulcers, associated with motor insufficiency (with an unbroken contour) of the stomach as it actually can be observed in a minority of cases of duodenal ulcer, should make the diagnosis certain. The secondary symptoms are not altogether characteristic of gastric ulcer, because they may be produced reflexly in the various organic and functional diseases, as enumerated above, without any actual participation of the stomach in the morbid condition.

In case of duodenal ulcer, there are likewise, direct signs observable over the duodenum and secondary accompanying symptoms are present over both the duodenum and the stomach. It must be emphasized that alterations pointing to the presence of organic involvement, such as niche, which alone can be visualized in about 60 or 66 per cent of all the duodenal ulcer cases, (Akerlund, Diamond) or retraction or diverticulum, were not observable over the duodenum in our case. With the exception of the bulbar defect, all of the numerous symptoms visible over the duodenum, were functional. Bulbar defect is usually classified among the direct signs of duodenal ulcer (Haudek, Cole, Akerlund), but recent researches have demonstrated that it may be observed,—especially when it is shifting in character—as functional, spastic alone without any organic involvement, as it was in our case.

The roentgenologic symptoms manifest themselves in our case in the classical picture of derangements characteristic of duodenal ulcer. High degree of bulbar deformity, defects, brought on by deep bulbar spastic contractions—bilateral "incisurae"—producing the so-called hour-glass form of the bulbus (a roentgen-ray finding very rare in itself, when E. Schlesinger had observed, as he mentions in his book (1917) only one case of hour-glass form of bulbus duodeni), also superficial, pea-sized, rounded, spastic bulbar defects, the duodenal muscle-syndrome: hypermotility of the bulbus with hypomotility of the lower horizontal portion, relaxation and dilatation of the latter, the triad of the "hypers," over the stomach (Schlesinger's excitative reflex-neurosis) as hypertonus, hyperperistalsis and hypermotility, which latter may, after the picture of a spastic pyloric stenosis is brought on by later spasms over the pylorus and bulbus duodeni, be followed by a subsequent hypomotility with secondary motor insufficiency (Kreutzfuchs' "tardivpylorospasm," Åkerlund's "tardivbulbospasm") hypersecretion (without hyperchlorhydria), rapid change in the motor power from high degree of hypermotility into high degree of motor insufficiency, completing the classical picture of the symptom-complex of the duodenal ulcer. *Whereas the symptoms of gastric ulcer were missing, those of duodenal ulcer were present in great number, and yet operation revealed that there were two callous ulcers of the lesser curvature* and at the same time the *duodenum was perfectly normal.* The fact did not escape our attention that the surgeon's negative findings after exposing the duodenum do not entirely exclude the possibility of the presence of small, superficial ulcers in the duodenum (Åkerlund, Carman, etc.). Being aware of that fact, we searched for ulcers in the duodenum laying stress on the careful and thorough palpation of that viscus. Under such conditions, the negative surgical findings in reference to the duodenum makes the presence of any duodenal ulcers very improbable, especially when we take into consideration the rather infrequent simultaneous occurrence of both the duodenal and gastric ulcers. As the gastric ulcers were chronic, callous, easily palpable through the serosa, simultaneous duodenal ulcers, when present at all, would have been expected to give the same easily recognizable appearance. Cancerous ulcers or tumors in the duodenum are otherwise quite exceptional findings. The combina-

tion and coincidence of all these in themselves rare occurrences would lend a special interest to the case.[1]

While all these findings provide evidence against the infallibility of the roentgen-ray diagnosis in cases in which they were supposed to be absolutely characteristic, there are other more cogent reasons why this case is worthy of careful interpretation. The question is one of *interrelationship between* the mechanism of the neuromuscular apparatus, which exists between *the stomach and other organs*, especially the duodenum. While it is a well-known fact that the various alterations in the abdominal organs (duodenum, appendix, kidney, genitals, etc.) may be associated with functional derangements in the nervous mechanism of the stomach (secondary symptoms), *it is not so well known that a primary lesion of the stomach may produce secondary disturbances in various other organs, as this case in the duodenum, or further, that the duodenum, like the stomach, may be the site of secondary involvement in primary affections of another organ and especially of the stomach.* This brings up the question of the possibility of an interrelationship between other organs, as for example, the appendix on the one hand and the stomach or duodenum on the other. It may be possible that in some cases duodenal or gastric ulcer produces reflex changes around the appendix, manifested by tenderness and reflex rigidity of the musculature, changes which may be corroborated by some roentgenologic findings in the appendix, etc. Many of the useless appendectomies in cases of gastric or duodenal ulcer, performed on the basis of the roentgenologic diagnosis support the assumption of a *reversible interrelationship* between these organs, such as seen to have been proved to exist between the stomach and duodenum in this case.

[1] The patient had gained 35 lb. two months after operation, and feels perfectly well.

BIBLIOGRAPHY

Akerlund, A. Roentgenologische Studien über den Bulbus duodeni. *Acta radiol.*, Suppl. 1, 1921.

Akerlund, A. Die Röntgendiagnostik des Ulcus duodeni mit Hinsicht auf die lokalen "direkten" Röntgensymptome. *Fortschr. a. d. Geb. d Röntgenstrahlen, Hamb.*, 1923, xxx, Kongressheft, 43–40.

Aschoff. Lectures held in Mt. Sinai and Lenox Hill Hospital, New York City, 1924.

Assmann, Herbert. Die klinische Röntgendiagnostik der inneren Erkrankungen. F. C. W. Vogel, Leipzig, 1922.

Baron, A., and Barsony, T. Spastischer Sanduhrmagen bei duodenalen Affektionen. *Wien. klin. Wchnschr.*, 1912, xxv, 1185–1187.

Bauer, J. Die konstitutionelle Disposition zu innerer Krankheiten. J. Springer, Berlin, 1917.

Carman, R. D. The Roentgen Diagnosis of Diseases of the Alimentary Canal. Saunders & Co., Philadelphia, 1920.

Diamond, J. S. Newer phases in the roentgen interpretation of duodenal ulcer. Am. J. Roentgenol. & Rad. Therap., 1924, xi, 317–328.

Gocht. Roentgenlehre. Ferdinand Enke, Stuttgart, 1918.

Groedel, F. M. Die typischen Roentgenbilder d. Magenbewegungen. Lucas gräfa und Sittem, Hamburg, 1912.

Kaufmann, J., and Galambos, A. Diseases of the Stomach, in Forcheimer-Billings-Blumer's, Therapeusis of Internal Diseases, Fourth edition. D. Appleton & Co., London and New York, 1924.

von Schjerning, O. Handbuch der arztlichen Erfahrungen im Weltkriege. Johann Ambrosius Barth, Leipsig, 1921.

Schlesinger, E. Die Röntgendiagnostik der Magen- und Darmkrankheiten, Urban and Schwarzenberg, Berl. & Wien, 1917.

OSTEOPSATHYROSIS (OSTEOGENESIS IMPERFECTA)

BY CLIFTON R. SCOTT, M.D.

Instructor in Radiology, Yale University School of Medicine

NEW HAVEN, CONNECTICUT

OSTEOPSATHYROSIS may be defined as a rare systemic disease of the bones, probably congenital in origin, characterized by a deficient and imperfect bone development associated with multiple spontaneous fractures. A good deal of confusion regarding its classification, etiology and pathogenesis has existed, as shown by the imposing array of synonyms used in its description by various authors and these features warrant the presentation of 2 cases, one of which seen in late adult life is somewhat unusual.

Probably the first case of this type of disease was published by Amand in 1716 as "Interuterine fractures without preceding trauma" and is quoted by Gurlt[1] in his analysis of cases published in 1862. Since that time many careful studies of the disease have been made although there still exists considerable confusion due to its close relationship to other diseases occurring in infancy which produce increased fragility of bones. Lobstein[2] in 1833 gave the first accurate and detailed description of the disease in cases occurring in infants and young children and coined the word or phrase "osteopsathyrosis idiopathica," meaning a crumbling or fragility of the bones of unknown etiology. Griffith[3] in 1897 collected 67 cases occurring in infancy and childhood and included in his group all cases of multiple fractures occurring before birth, at birth and after birth in which no definite cause for the bone fragility could be found. Ostheimer[4] in 1914 reported one case and collected from the literature 124 cases in addition to the 67 reported by Griffith, making a total of 193 reported cases. Since this time many excellent articles have appeared in the literature and for a more careful analysis and survey of the subject the reader is referred to the accurate studies by Locke,[5] Hess,[6] and Schwarz and Bass.[7] Ostheimer[4] gives an extensive review of the literature up to the year 1914.

The direct cause of the disease is unknown but most authors agree that there is no essential difference in the disease at different age periods and although appearing late the disease is congenital in origin. Lobstein[2] was the first to note a hereditary tendency in the disease, and Griffith estimates that approximately 42 per cent of his cases show a hereditary factor. Males are slightly more commonly affected than females and it is thought that the transmission of the disease is through the male side. Eddowes[8] in 1900 was the first to describe an azure or deep blue tint of the sclera seen in many of these cases and this association has been noted by many authors. Kienbock[9] expresses the opinion that the disease is not a primary bone affection but is due to some disturbed function of central origin governing bone metabolism. Whether or not this disturbed function be central in origin is hard to state and we may sum up our present knowledge of the etiology of the disease with the statement that it is due to some disturbance of bone metabolism which affects the entire osseous system and occurs during fetal life.

The primary pathological changes are the same throughout the entire osseous system but are best observed in the long pipe bones of the extremities. In fact, the fractures are almost entirely confined to the long bones and the ribs. The primary growth in length is approximately normal and the epiphyseal line is usually sharply cut and straight. The cortex is very thin and medullary space unusually wide, giving the bones an unusual delicacy and slenderness. Marked deformities of almost every type may be seen due to the multiple fractures or bending of the bones. They may appear short and plump with numerous annular thickenings due to callus formation, or show sharp angular deformities with regular even bowing. Fractures are exceedingly common. Mixsell[10] quotes the case of Chaussier with 113 fractures. Callus formation and healing usually take place rapidly in the older cases although at times fibrous union or complete

absorption of the ends of the fragments may occur. The marked bowing of the bones is usually seen in the older cases and is the result of stress or strain in moving about, being most marked in the legs and forearms. Likewise, postural changes in the spine, such as scoliosis and varying degree of kyphosis are many times present.

On section the bone appears soft and friable although the lime content may appear normal. The epiphyses are normal although the proliferative zone of cartilage appears somewhat narrow and bone deposition much decreased. Large marrow spaces replace the normal Haversian system (Nichols[11]), and there is a marked increase in the medullary substance over spongiosa. Osteoclasts are markedly increased in number and osteoblasts markedly decreased. No cysts are seen as is sometimes the case in osteomalacia, and Biggs[12] notes that the absorbed bony tissue is not replaced by connective tissue as in osteomalacia. The general microscopic appearance is greatly altered according to the duration of the disease and to its progressive or regressive nature.

The roentgenographic appearance of the bones is so characteristic and typical that it cannot be confused with any other disease and is well summarized from the literature by Locke[1] as follows: (1) A high degree of osteoporosis uniformly affecting the entire skeleton, the variations in density giving a mottled appearance; (2) marked deformity of the long bones of the extremities usually of an angular type and due to evident fractures, rarely also some actual bowing; (3) apparent normal size and shape of bones except as altered by fractures and callus formation; (4) often excessive callus formation with variable degree of calcification. A transverse area of decalcification is often seen at the point of a previous fracture; (5) the epiphyseal line is straight, cartilage very thin; (6) a very faint shadow is given by all the bones, frequently scarcely more dense than the surrounding soft parts; (7) the cortex is thin, irregular and deficient in lime salts; (8) the spongiosa of both epiphyses and diaphyses is extremely faint with entire absence of all normal markings; (9) the medullary cavity is very irregular in outline and appears dilated.

The following two cases are more or less typical of the disease and show the bone changes and the resulting deformities.

Case I.

History. A premature infant, case of Dr. Rand, delivered at the New Haven Hospital and living only one hour. The mother, an American, young, healthy, a primipara in the eighth month of pregnancy gives no past history of note and has since been delivered of a normal healthy child.

Clinical Findings. The premature infant was a female, length 33 cm., weight 1310 grams. The measurements of the head were as follows:

	Premature infant, cm.	Normal (Riggs[11]), cm.
Fronto-occipital	9.5	11.75
Biparietal	10.0	9.25
Bitemporal	7.0	8.00
Mento-occipital	11.5	13.50
Suboccipital-bregmatic	7.0	9.50

At first the infant was thought to be an achondroplastic dwarf. The head was large in proportion to the body and the extremities appeared unusually short. This shortening, however, was due to a marked bowing or angulation in the mid-shaft of the long bones and upon manipulation crepitus was plainly elicited. The skull was large, thin and seemingly made up of numerous small pieces, approximately 2 cm. in diameter. The eyes were prominent, associated with a divergent strabismus and the sclera were of a distinct bluish tint. Roentgenographic examination showed the typical decreased density of the bones throughout with multiple fractures of the long bones and ribs. It was impossible to show the numerous small bones of the skull due to the extreme thinness of the bones (Figs. 1, 2 and 3).

Case II.

History. A single, American born, white female, aged fifty-five, entered the New Haven Hospital complaining of pain in the lower back. The family history is essen-

tially negative while the patient's past history and present appearance is extremely interesting. Patient states that she was deformed at birth and at that time had numerous fractures of the long bones. She has never walked and has spent the greater part of her life in a wheel chair but is now able to care for herself fairly well. At the age of thirteen the fragility of the bones became somewhat increased as shown by the occurrence of numerous spontaneous fractures which healed poorly. Recently, very curious deformities, which are best shown by the accompanying roentgenograms. The laboratory findings were essentially negative.

Roentgenographic Examination.

Skull. The anteroposterior diameter is slightly increased, otherwise skull is normal shape. Face seems relatively small in proportion to skull which is fairly large. Tables are thin and sutures are only faintly visible. Circulatory depressions are normal except for unusual prominence of

FIG. 1. Case 1. Roentgenogram of entire skeleton showing multiple fractures of the long bones and ribs.

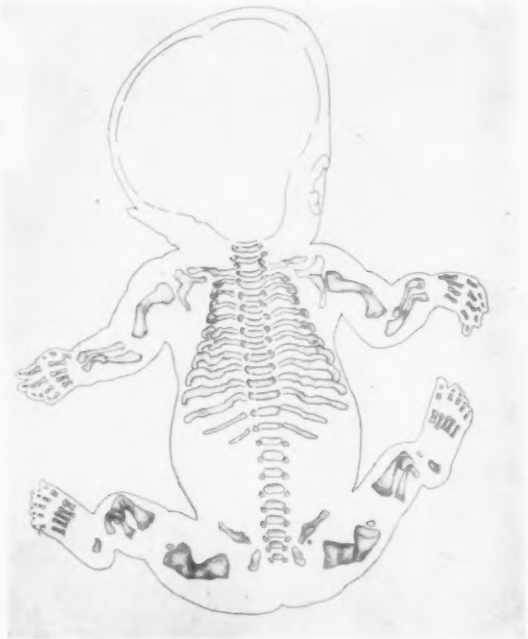


FIG. 2. Case 1. Tracing of roentgenogram showing more clearly the location of fractures.

however, she has had no fractures and except for the slight pain in her back is in excellent health.

Clinical Findings. The patient presents a most striking appearance. She is approximately four feet in height and usually lies in a semi-recumbent position but is able to move about slightly by means of a peculiar waddling or swinging movement of the trunk and lower extremities. The head is relatively large, face small, hair somewhat scanty and the sclera show a distinct bluish hue. The trunk is rather short and there is a mild degree of kyphosis present. Extremities are very short and due to the extensive fractures and bowing present

the middle meningeal arteries. Sinuses are large and normal in appearance. Sella turcica is somewhat shallow but otherwise normal in appearance.

Clavicles and Scapulae. Normal in appearance except for slight anterior bowing of left clavicle.

Humeri. The humeri are approximately the same and the right alone will be described. The right arm is approximately 17 cm. in length. The head and extreme upper ends are fairly normal in appearance. The shaft below head decreases rapidly in width, and 10 cm. from upper end terminates in a series of very small bone fragments which extend to a rather

small and somewhat deformed condylar end. There evidently has been an almost complete absorption of the shaft for approximately 5 cm.

Radii and Ulnae. The right radius and ulna measure approximately 22 cm. in length, appear very delicate and slender but are fairly straight. The coronoid process of the ulna shows some slight deformity and there evidently has been an old fracture of the ulna 4 cm. from the lower end which is well healed. The left ulna and radius show a marked, somewhat irregular anterior bowing with a considerably increased width or flattening of the radius. No definite fractures are noted but the ends show some irregularity which are suggestive.

Pelvis. The pelvis is rather small, shows a generalized decreased density throughout and is asymmetrical in shape. The pelvis inlet is somewhat asymmetrical and approaches the "ace of heart" or "trefoil" shaped pelvis seen in osteomalacia.

Femora. The femora are relatively short measuring approximately 26 cm. in length. The right shows a well-marked outward bowing in the mid shaft and is considerably increased in width, measuring in mid shaft 5 cm. There evidently has been a fracture at this point with heavy callus deposited along the concave side. The left femur likewise shows a well-marked outward bowing with the evidence of an old ununited fracture of the shaft 7 cm. from upper end. Several small loose

FIG. 3. (Negative retouched.) Osteochondrodystrophia fetalis. Showing the typical short, plump, heavy long bones. Contrast with long bones of Case 1.

FIG. 4. Case 11. Roentgenogram showing arms and forearms of adult case. Note almost complete absorption of mid shaft of humeri; old fracture of lower end of right radius and marked deformity of left ulna and radius. Bones of forearms are of normal length but are very slender and delicate in appearance.

fragments of callus are seen along inner margin.

Tibiae and Fibulae. The left tibia and fibula are approximately 32 cm. in length, and appear very slender and fragile. There is a well marked anterior bowing of both bones with some slight thickening along concave side, although this is not marked; no fractures present. The right tibia and fibula show a marked degree of anterior bowing with considerable outward bowing of fibula. Some slight thickening on concave side of fibula but tibia is of approximately normal width. No fractures are noted although there is a partial anterior dislocation of both knee and ankle. The hands and feet are essentially negative except for the generalized bone changes throughout (Figs. 4, 5 and 6).

FIG. 5. Case II. Roentgenogram showing pelvis and femora. Note old ununited fracture of right femur and heavy callus formation on inner surface of left femur.

FIG. 6. Roentgenogram of left and right legs showing the marked anterior bowing of right tibia and fibula with well-marked inward bowing of the left tibia and fibula.

The differential diagnosis from a roentgenographic standpoint is usually not difficult and the general appearance of the bones is more or less typical. The disease which causes the most confusion in diagnosis due to extreme fragility of the bones in infancy is rickets in an advanced form. So far as we know, rickets is not a congenital disease and likewise gives a fairly characteristic picture with marked flaring and lipping of the epiphyseal end of the diaphysis, periosteal thickening, regular bowing, and heavy repair on the concave surface of the deformed bone. Multiple fractures may occur in rickets but are usually not marked, are not periosteal in bone type and show poor callus formation. Repeated roentgenograms following intensive treatment in rickets show calcium deposition and repair to take place very rapidly and the differentiation is usually not difficult.

The general prognosis in cases of osteopsathyrosis is extremely bad. The majority of the children are stillborn or die soon after birth. In the severe early form the mortality is approximately 100 per cent, although Ostheimer[4] in his series reports 65 per cent of the cases to be living. Hess[6] states that there are periods of exacerbations and remissions of the

severity of the disease and Kienbock[9] has noted recurrences many years after apparent cures. The fragility of the bones seems to decrease as age advances and the patient may enjoy extremely good health except for the usually severe old deformities.

The general consensus of opinion regarding treatment is that it should follow the same line as that of rickets. Bookman,[14] from metabolism studies, concludes that the calcium retention is usually low and that this calcium deficit may be favorably influenced by the administration of cod-liver oil. Extreme care in the prevention and after treatment of the fractures is essential. There is usually little pain associated with the fractures and crepitus may be absent, making an early diagnosis of fracture difficult and bringing the patient to the physician only after multiple fractures have occurred and non-union perhaps is already established.

BIBLIOGRAPHY

1. Gurlt, Ernst. Handbuch der Lehre von den Knochenbrüchen. G. Grote, Hamburg, 1862–1864.
2. Lobstein, J.-G.-C.-F.-M. Traite d'anatomie pathologique. F.-G. Levrault, Paris, 1829–33, p. 204.
3. Griffith, J. P. C. Idiopathic osteopsathyrosis (fragilitas ossium) in infancy and childhood. *Am. J. M. Sc., Phila.*, 1897, cxiii, 426–445.
4. Ostheimer, M. Fragilitas ossium. *J. Am. M. Ass., Chicago*, 1914, lxiii, 1996–1999.
5. Locke, Edwin A. Diseases of Bones. Oxford Medicine, Oxford University Press, 1921, iv, 452.
6. Hess, J. H. Osteogenesis imperfecta. *Arch. Int. Med., Chicago*, 1917, xix, 163–193.
7. Schwarz, H., and Bass, M. H. Osteogenesis imperfecta; report of a case with the study of its metabolism. *Am. J. Dis. Child.*, 1913, v, 131–142.
8. Eddowes, A. Dark sclerotics and fragilitas ossium. *Brit. M. J., Lond.*, 1900, ii, 222.
9. Kienbock, R. Ueber infantile Osteopsathyrose. *Fortschr. a. d. Geb. d. Röntgenstrahlen, Hamb.*, 1915, xxiii, 122–168.
10. Mixsell, H. R. Osteogenesis imperfecta (osteopsathyrosis, fragilitas ossium), with report of two cases. *Arch. Pediat., N. Y.*, 1917, xxxiv, 756–764.
11. Nichols, E. H. Osteogenesis imperfecta. Surgery, Its Principles and Practice. Edited by W. W. Keen. W. B. Saunders & Co., Philadelphia, 1909, vol. ii, p. 51.
12. Biggs, M. H. Osteopsathyrosis: with the review of a case having sustained twenty-two fractures in a period of ten years. *Univ. Penn. M. Bull., Phila.*, 1902–03, xv, 488–493.
13. Riggs, Theodore F. A comparative study of white and negro pelves, with a consideration of the size of the child and its relation to presentation and character of labor in the two races. *John Hopkins Hosp. Rep., Balt.*, 1904, xii, 421–454.
14. Bookman, A. The metabolism in osteogenesis imperfecta with special reference to calcium. *Am. J. Dis. Child.*, 1914, vii, 436–444.

DIVERTICULOSIS AND DIVERTICULITIS OF THE COLON

BY CHARLES D. ENFIELD, M.D., F.A.C.P.

LOUISVILLE, KENTUCKY

IT is perhaps almost an impertinence to suggest that there exists any general need for greater thoroughness in the roentgen examination of the gastrointestinal tract. Certainly this would be the case with regard to the upper tract, upon which the examiner's attention is usually centered. There seems, however, to be a temptation, even with painstaking workers, to make the concluding phase of the gastrointestinal examination—the study of the colon—more or less routine. Whatever the cause may be it is generally admitted that more lesions of the lower, than of the upper tract are overlooked by the roentgenologist.

One great reason may be that the examination itself is technically more difficult. Palpation is not of so much help in determining colonic lesions as it is in gastric or duodenal conditions. The standards of motility are less reliable and more variable. There are more possibilities of confusing shadows. The stomach is practically always examined under known and standardized conditions, while the condition of the colon is usually more or less conjectural. It may be practically empty, or it may contain partial fecal accumulations of several days. For these reasons, if one is to detect a creditable percentage of lesions of the lower bowel it is especially necessary to be constantly on guard lest the slightest reasonable suspicion of abnormality pass unnoticed, and to employ the same care and diligence used in the study of the upper tract.

These statements are called forth because of the relative frequency with which cases of colonic diverticulosis are now being found as compared with a few years

ago. The actual *incidence* per hundred gastrointestinal examinations may be the same, but at the present time we are finding three or four times as many of them. We now recognize the type of shadow which suggests diverticula before they are actually filled, and we then endeavor to secure roentgenograms when they are filled.

The entire intestinal tract is subject to diverticulosis, but the pathological, pouched-out areas in the intestinal wall are much

FIG. 1. After meal and enema, showing spasm and diverticula in descending colon and sigmoid.

more common in the large, than in the small bowel. In the small bowel, diverticula of the acquired type are most often reported arising from the first or second part of the duodenum. Meckel's diverticulum, due to persistence of the omphalomesenteric duct, is found rather frequently at operation and at autopsy but is rarely diagnosed by the roentgenologist. The roentgen diagnosis of colonic diverticula is, on the other hand, frequently made, while recently numerous workers, particularly Case of Battle Creek, have reported series of duodenal diverticula.

It is rather odd that so recent and voluminous a work as the Oxford Medicine disposes of the entire subject of diverticulitis of the colon in about two pages, while Keen's Surgery (1908) treats the subject even more summarily. The latter work does not mention the roentgen ray in the diagnosis of the condition, while the former (1921) states that "Radiography" is the important factor in the diagnosis. The roentgen diagnosis of this condition has been developed and worked out during the past few years, especially by Carman who devotes an interesting chapter to it in his book: "The Roentgen Diagnosis of Diseases of the Alimentary Canal."

FIG. 2. Same patient as in Figure 1, 24 hours after enema, 48 hours after meal. Diverticula still filled.

Colonic diverticula occur most frequently in individuals past forty years of age, and an antecendent history of chronic constipation seems to be rather more common than is general in patients who appear for gastrointestinal study. Statistics show that males are affected two or three times as often as females. (Greater muscular activity herniating the mucosa through the muscularis?) The typical patient is rather obese, not anemic, apparently not very sick. In many respects he is the male counterpart of Deaver's typical gall-stone patient, the original of the famous diagnostic catch phrase, "fair, fat and forty." An inquiry as to the major complaint will, in patients who have not had a recent

acute attack, usually bring out mention of a pain or soreness in the lower left quadrant; sufficiently unusual in itself to be suggestive.

From the pathological standpoint colonic diverticula are, when not congenital, practically all of the "false" type; that is, they consist of a herniation of the mucosa through the muscularis, while on the outer surface of the bowel, if the situation permits, there is often a patch of adhesive peritonitis. They vary in number, in the individual case, from one to three or four

FIG. 3. Spastic sigmoid with diverticula, 48 hours after meal, just after enema.

hundred. They are most commonly found in the sigmoid and descending colon, but are not infrequent in the rectum, and may occur in the cecum, in the transverse colon or indeed at any point in the bowel. They are found most commonly at the antimesenteric border, next most frequently at the mesenteric border, and occasionally on either wall irregularly located. Properly speaking the condition, unaccompanied by inflammatory process, should be referred to as "diverticulosis;" when there is an inflammation it becomes diverticulitis, and perhaps always a peridiverticulitis as well. The reaction about the individual diverticulum giving the trouble may cause a mass of inflammatory tissue to be built up to far larger dimensions than the original diverticulum. There is of course a tendency for fecal matter to accumulate in the pouches, and this is probably the cause of the inflammatory reaction which gives rise to the acute symptoms. In not a few instances these fecal accumulations have been reported as of the consistency of chalk, and sometimes of considerable size, forming veritable fecaliths.

The cases seen clinically fall into three distinct groups as regards symptomatology. First and most numerous, are the ones discovered incidentally to a gastrointestinal study undertaken with other pathology in view. Case reports that one in 80, or 1.2 per cent of the routine gastrointestinal roentgen examinations at Battle Creek disclose colonic diverticula. It is my impression from my own experience that at least half the cases I have encountered have had none of the typical symptoms of diverticulitis.

The second group, and I think this is second in point of frequency as well, have vague symptoms referable to the lower intestinal tract, of which the most constant are left lower quadrant tenderness and occasional left lower quadrant pain of moderate severity. As previously stated they are usually severely constipated. They often, but not regularly, have bladder irritability, tenesmus and other urinary symptoms. On physical examination, if the abdominal wall is not too thick, a spastic, thickened, rope-like sigmoid can be felt, and rolled under the examiner's fingers; this part of the bowel is usually tender. Proctoscopic examination is usually negative, and as a rule nothing abnormal is noted about the character of the stool. The blood picture is usually normal. The combination of the lower left side pain or tenderness, or both, with chronic constipation and a palpable sigmoid or descending colon should suggest diverticulitis.

The third group comprises the cases which develop acute diverticulitis. These cases exhibit the symptomatology of left sided appendicitis, with acute pain, tenderness, muscle spasm, increased white blood count and fever. While these symptoms may develop suddenly without previous history of left side pain and tenderness,

they usually come from the second group, with a history of vague and not very severe symptoms extending back over months or years. Pathologically this condition is an acute inflammatory reaction about the diverticulum which happens to be making trouble, and which may be the only one present or one of several score. It may cause merely a localized peritonitis, with or without actual perforation, or may lead to a general peritonitis, through failure to wall off.

Aside from the possibility of perforation, chronically inflamed diverticula occasionally undergo carcinomatous change.

As indicated, the symptoms and history may, and often do point the way, but the decisive factor in the diagnosis is always the roentgen-ray examination. The roentgen-ray appearance of these cases is very characteristic and once seen in a typical case is not apt to be forgotten. There is, however, often some difficulty in bringing out the typical appearance on the films or under the roentgenoscopic screen. These pockets, being already filled with fecal matter, do not readily outline with the barium mixture and the first examination, even in a case with numerous well-marked diverticula may show no filled pockets. In such cases, however, the involved portion of the bowel nearly always presents a ragged spastic appearance which, while not characteristic, is suggestive, and should lead to further observation.

If the entire gastrointestinal tract is being examined—this is best even if a clinical diagnosis of diverticulitis has already been made—the 24-hour examination of the colon may show one or more small, dense, rounded or oval shadows outside the bowel wall, but connecting with it; or may show filled pockets as areas of heavily increased density overlying a portion of the bowel lumen, where the diverticula are not at the mesenteric or anti-mesenteric border. Or, as frequently happens, the sigmoid or descending colon may merely present the characteristic spastic appearance which suggests the advisability of further examination. In either event it is our custom to give an additional amount of barium by mouth and observe the patient again 48 hours after the first, and 24 hours after the second barium meal.

The second observation of the colon will probably show additional pockets filled, or if there was only spasticity at the previous examination, one or more diverticula may show distinctly. According to the appearance of the bowel, the examination may be concluded by an enema at this time, or the patient may be observed for an additional day or two before the enema is administered. Films made twenty-four hours after the enema, or even two or three days after, will usually show some of the pockets still filled. They empty quite as reluctantly as they sometimes fill.

In the typical case with many rounded or oval pockets coming off from the descending colon and sigmoid the roentgen appearance is so characteristic that there can be no question as to the diagnosis. Cases with only one or two diverticula, with a small number of diverticula in an unusual part of the bowel, or with diverticula which do not fill well, or are irregular in outline, sometimes present some difficulty in diagnosis. If the gastrointestinal routine includes one or more films made of the whole abdomen over the Bucky diaphragm before any barium is administered, fecaliths, calcified glands, and urinary calculi are eliminated as possible confusing factors. Barium pent up in contracted haustra may occasionally resemble diverticula, but manipulation during screen examination, and particularly a series of films after the meal and after the enema will serve to differentiate this from true diverticula.

The ideal sequence for confirming a diagnosis of diverticulitis consists in visualizing the filled pockets after the barium meal, allowing the colon to empty until only the filled diverticula are shown on a 48- or 72-hour film, and then demonstrating them as extra-luminal shadows after the enema. If sufficient care is taken to work out the cases from the roentgen standpoint it will be very rarely that the question between a malignant obstruction of the sigmoid and the similar ragged obstructive defect from a diverticulosis will have to be left open through failure to fill the diverticula with barium.

CHRONIC STENOSIS OF THE DUODENUM

BY NÁNDOR RATKÓCZI, M.D.

Director of the Roentgen Department

From the Third Medical Clinic of the Royal Hungarian University at Budapest, Professor A. de Koranyi, Director

BUDAPEST, HUNGARY

FOOD which enters the stomach is gradually propelled by the peristaltic action of the antrum into the duodenum. It remains for some seconds in the bulbus and is then quickly driven by peristaltic action through the remainder of the duodenum into the jejunum. The entire extent of the duodenum is visible only when the contrast material flows without interruption because of pyloric insufficiency or when an artificial obstruction is produced by compression of the duodenojejunal junction, or when there is natural organic obstruction at the latter point.

FIG. 1. Filling of the entire duodenum due to pyloric insufficiency. The Kerkring folds are well seen and lie close together.

Roentgenographic appearances of the duodenum differ in accordance with their origin. With pyloric insufficiency the Kerkring folds lie close to each other and are well seen (Fig. 1). With stenosis artificially produced the folds are not so close together, and dilatation of the duodenum is not seen at all or is only moderately perceptible. With the stenoses I am about to describe the duodenum is well filled, the distal parts are considerably dilated and the Kerkring folds are partially or entirely obliterated; the duodenum has a sausage-like appearance and may attain the diameter of the colon (Fig. 2). Prior to the roentgen era, duodenal stenoses were confused with pyloric stenoses; only the roentgen examination revealed them as independent, though rare, disease entities. The acute duodenal stenoses which mostly appear after narcosis will not be treated here.

In chronic duodenal stenosis the duodenum may be enlarged to the size of a man's fist or even larger, to form a so-called "second stomach." The stenosis in the duodenum causes a delay in the evacuation of the stomach which at first attempts to overcome the obstruction by increased peristaltic action, but finally becomes atonic. Ectasia occurs when the picture is that of pyloric stenosis with the only difference that the obstruction is at a lower point.

Based on the cases mentioned in the literature and from my own experience

I have divided the chronic duodenal stenoses into two classes: (1) Persistent stenosis, and (2) intermittent stenosis.

In persistent stenosis the contrast material trickles constantly through the duodeno-jejunal junction, but only in a thin jet; the duodenum is completely filled because of the constant supply from the antrum. More or less violent antiperistalsis of the lower section of the duodenum may drive the food back into the bulbus and even into the stomach. The evacuation of the stomach may be delayed six to twenty-four hours. In the enlarged, sac-like horizontal portion of the duodenum there may be perceived after six to twelve hours the flake-like remainder of the contrast food.

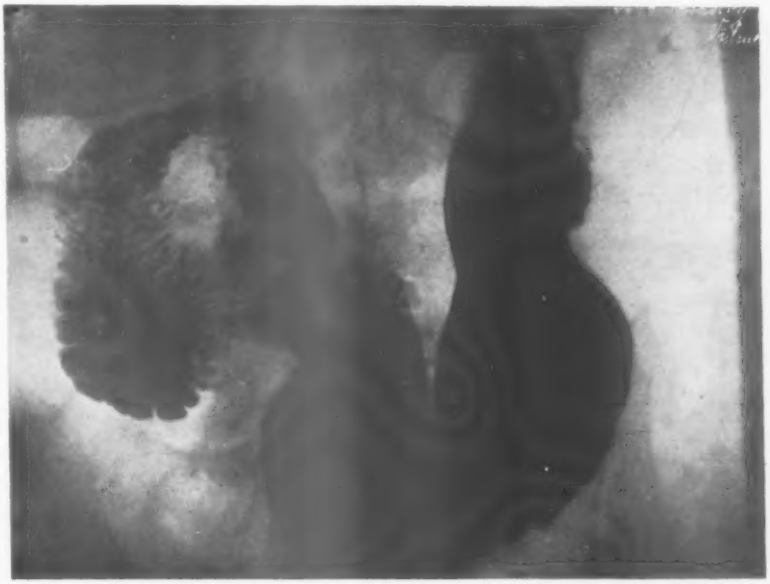


FIG. 2. Dilatation of the duodenum due to obstruction at the duodeno-jejunal junction.

The following are to be considered among the causes of duodenal stenoses: (1) Adhesions after laparotomy; (2) adhesions due to peritonitis, tuberculous or from other causes: (3) tumors of the pylorus, the pancreas, retroperitoneal glands, etc.

In the intermittent duodenal stenoses, which are found mostly in connection with intensified peristalsis of the stomach, the contrast material fills the duodenum completely to the duodeno-jejunal junction and stops there as if at an absolute obstacle. There is at the same time a strong antiperistaltic action of the horizontal and descending portions of the duodenum which drives the food back into the bulb and even back to the stomach. Renewed antrum peristalsis again fills the duodenum and the play of this "pendulum movement" may continue for two to twenty minutes. The duodeno-jejunal junction then suddenly opens and the contrast food pours in a thick jet into the jejunum. The stomach evacuates well if after a quarter or half an hour's time there is no repetition of the stenosis, but with a long persisting or rapid repetition of the constriction the evacuation of the stomach is delayed several hours, which may finally result in a considerable secondary ectasia of the stomach.

CASE 1. Miss H. H., aged twenty-two. Admitted July 2, 1923. Has suffered from indigestion for the past six months and from intense pain in the epigastrium two to three hours after meals. Frequent vomiting and tasteless eructations. Has undergone ulcer treatment without result. On May 16, 1923, she underwent a laparotomy but the details of the operation cannot be obtained. At present she is greatly emaciated and complains of marked pain in the epigastrium.

Roentgen examination. Solitary knot of hemp-corn size in the apex of the right lung. Stomach drawn to the right, pylorus open, the duodenum is pulled down but not deformed.

Diagnosis. Peripyloric and periduodenal adhesions. Discharged with ulcer diet. Readmitted October 12, 1923, complaining of nausea, vomiting, diarrhea and further loss in weight.

Roentgen examination at this time showed the stomach 3 inches below the navel, atonic and drawn somewhat to the right; pylorus open. Contrast food quickly fills the duodenum, stops for a short time at the genu inferior of the pars descendens, and for a longer period at the duodenojejunal junction. The duodenum is completely filled after a few minutes, is much dilated and has a stricture at the genu inferior (Fig. 3). Two-thirds of the contrast meal remains in the stomach and in the enlarged horizontal portion of the duodenum at the end of three hours. Both stomach and duodenum are empty at the end of six hours.

FIG. 3. Dilatation of the duodenum due to obstruction as a result of periduodenal adhesions.

Diagnosis. Periduodenal adhesions with duodenal stenosis of the second degree. Medical treatment without result. Laparotomy, November, 1923. Stomach and duodenum markedly dilated. Firm adhesions between the pylorus and duodenum. Gastroenterostomy performed. Readmitted December 7, 1923, in a weak and emaciated condition and suffering with general abdominal pain independent of taking food, and with frequent vomiting.

Roentgen examination, December 10, 1923. Gastroenterostomy functioning well. The stomach evacuates itself in ten minutes. Placed on Sippy treatment and discharged as recovered on January 7, 1924. Readmitted April 30, 1924. After a short period of freedom from symptoms the patient has again suffered from constant intense convulsive pains, especially after the reception of food.

Roentgen examination shows the gastroenterostomy patulous, and rapid evacuation of the stomach. There is delay for four hours, however, in the enlarged jejunal coils. There is marked localized tenderness on pressure over the gastroenterostomy stoma.

Diagnosis. Residual ulcer at the gastroenterostomy stoma and perijejunal adhesions.

CASE II. Mr. J. T., aged forty-three. Admitted April 8, 1924. For past three months has had intermittent attacks of pain in the lumbar region and in the lower part of the adbomen. For the past ten

days has had intermittent attacks of intense pain in the region of the kidneys.

Roentgen examination on April 12 shows an atonic, ectatic stomach drawn to the right and with well-marked peristaltic action. The entire duodenum is greatly dilated and the contrast meal stops sharply at the duodeno-jejunal junction. On the greater curvature of the stomach just proximal to the pylorus there is visible a defect the size of a hazel nut (Fig. 4). Practically none of the meal has left the stomach at the end of five hours, p.c., and there is a small residue at the end of twenty-four hours.

Diagnosis. Prepyloric tumor compressing the duodeno-jejunal junction.

Operative Findings. Tumor-like, callous ulcer at the pylorus with perforation into the pancreas.

Resection and Kocher anastomosis.

Microscopic Findings. Callous ulcer with carcinomatous degeneration.

Case III. Mr. K. S., aged twenty. Admitted August 21, 1922, with history of extirpation of testicles on June 17, 1922. For past two weeks has had constant pains in the back and in the epigastrium, accompanied by frequent vomiting. There is a hard palpable tumor about the size of a man's fist in the right half of the abdomen which does not follow the respiratory movements.

Roentgen examination, August 23, 1922. Stomach of the fish-hook type with greater curvature at the level of the navel, moderate peristaltic action, pylorus free. Contrast meal stops at the duodeno-jejunal junction but after a few minutes flows seemingly without interruption into the jejunum. Two hours, p.c., the stomach and duodenum are empty.

Diagnosis. Intermittent duodenal stenosis due to compression at times by an extraventricular tumor.

August 23 and 24, roentgen irradiation of the tumor from 3 fields. August 27, the tumor is visibly smaller. August 28, the patient felt perfectly well but after a walk suddenly collapsed, with cyanosis and small frequent pulse and died about noon on August 29.

Autopsy showed a retroperitoneal tumor of the size of a child's fist with sanious decomposition in the center; small sarcomatous metastases in both lungs.

Case IV. Mrs. V. P., aged sixty-six. Admitted May 15, 1924. Has suffered from indigestion since childhood. For the past five weeks has had pains in the region of the stomach, feeling of distention, heart-burn and lack of appetite. Lately has lost considerable weight.

Roentgen Examination. Stomach 5 inches below the navel, peristalsis violent, pylorus patulous. The contrast material flows quickly into the considerably enlarged duodenum and delays for a few minutes at the duodeno-jejunal junction (Fig. 2). After two hours about half of the meal remains in the stomach and there is also considerable residue in the pars inferior of the duodenum (Fig. 5).

Fig. 4. Dilatation of the duodenum due to compression by a prepyloric tumor.

Diagnosis. Intermittent stenosis of the duodenum due to periodic compression of the duodeno-jejunal junction by the mesentery or the superior mesenteric artery as a result of the gastroenteroptosis.

Case V. Mrs. F. B., aged twenty-one. Admitted January 2, 1924. For the past year has suffered from pains in the epigastrium and lack of appetite. Nausea without vomiting. Has lost markedly in weight during the past two years. There is definite tenderness on pressure in the epigastrium.

Roentgen examination shows an atonic, moderately dilated stomach, with the greater curvature a palm's breadth below

the navel. Pylorus patulous. Duodenal bulb fills well and is not deformed. Contrast meal stops at the duodeno-jejunal junction and is driven backward by intenes antiperistalsis into the bulb. This pendulum movement lasts for about ten minutes, when the duodenum evacuates itself. After this the bulb cannot be filled, except when the patient lies on the right side. Four hours later about half of the contrast meal remains in the stomach.

Diagnosis. Stenosis at the duodeno-jejunal junction caused by spasm or by pole a palm's breadth below the interiliac line. Pylorus patulous. Contrast material stops for a few minutes at the duodeno-jejunal junction. The distal portions of the duodenum are dilated. At two hours, p.c., about half of the meal remains in the stomach, and small amounts are present in the horizontal portion of the duodenum.

Diagnosis. Intermittent stenosis at the duodeno-jejunal junction. After three months' diet treatment the patient entirely recovered from her symptoms. The appe-

FIG. 5. Residue in the dilated duodenum four hours, p.c., due to periodic compression at the duodeno-jejunal junction by the mesentery as a result of extreme ptosis.

pressure of the mesentery resulting from the marked gastroenteroptosis. Sippy treatment produced no change in the symptoms. Another roentgen examination on April 14, 1924, showed the same condition described above.

CASE VI. Miss M. K., aged twenty-seven. For the past year has suffered from pressure-like pains in the epigastrium, becoming more severe immediately after meals, and radiating to the back. Eructation but no vomiting. Physical examination shows marked emaciation, abdomen relaxed. General tenderness on pressure over the epigastrium.

Roentgen examination, May 19, 1923, shows an atonic stomach with the lower

tite increased and there was an increase of weight.

Roentgen examination at this time showed the greater curvature of the stomach only 2 inches below the navel. The lower part of the duodenum was somewhat dilated but there was no perceptible delay in its evacuation.

CASE VII. Mr. J. P., aged fifty-one. Admitted December 5, 1922. Twelve years ago for a period of two years had had attacks of pain in the epigastrium immediately after eating, and accompanied by vomiting. He was then free from symptoms for several years but for the past seven years has had frequent attacks of cramp-like pains in the region of the stomach

independent of taking food. There has been improvement from time to time but never complete freedom from symptoms. The condition has grown worse during the past six months. He now has daily severe pains occurring two hours after meals and lasting for four to six hours. Relief after vomiting. Marked loss of weight during the past six months.

Roentgen Examination. Small hypertonic stomach with active peristalsis; duodenal bulb small and deformed; the descending and horizontal portions of the duodenum dilated and completely filled. Two hours, p. c., evacuation is slow and the distal parts of the duodenum are still well filled; four hours, p.c., stomach and duodenum empty.

Diagnosis. Callous ulcer of the first portion of the duodenum with periduodenal adhesions. Intermittent spastic stenosis at the duodeno-jejunal junction. Operation showed callous ulcer of the first portion of the duodenum.

From these reported cases and others, the reports of which are not reproduced, it is evident that there may be different causes of intermittent duodenal stenoses. In Case III it was movable tumor which because of its location and size could cause intermittent obstruction at the flexura. In Cases IV, V and VI, the obstruction was produced by the abnormal location of the stomach and small intestines due to marked emaciation which resulted in traction on the mesentery.

In other cases there were no anatomical changes perceptible at the point of obstruction. It is possible that there may be a functional spastic contraction which is responsible for the obstruction in some cases. It is impossible to exclude such spasm although I do not go so far as Kreuzfuchs and Weiss who presume a facultative sphincter at the duodeno-jejunal junction. Holitsch, who also noticed this stoppage of shorter or longer duration, compares it with a distant spasm of the pylorus due to gastric ulcer at a distance from the pylorus and believes that lesions of the duodenum might similarly produce distant spasm at the duodeno-jejunal junction. In the report of his 3 cases of "megaduodenum," Melchior does not give any anatomical causes. Barber is of the opinion that the spasm may be produced reflexly from the intestines (chronic appendicitis, constipation, typhlitis). These ideas are in accordance with my observation that after the disappearance of the clinical symptoms these intermittent stenoses also disappear. Among the 4500 stomach examinations made in this institution during the past two years we have encountered 29 duodenal stenoses. It may therefore be fairly stated that this condition, although not a daily occurrence is, after all, not the extreme rarity which it is generally considered.

SUMMARY

1. Chronic duodenal stenoses are divided into two groups: (*a*) persistent, and (*b*) intermittent.

2. Causes of persistent stenoses are, (*a*) adhesions after laparotomy, (*b*) adhesions due to tuberculosis and peritonitis, and (*c*) tumors of the stomach, pancreas, etc.

3. Causes of intermittent stenoses are, (*a*) movable tumors, (*b*) pressure of the mesentery or the superior mesenteric artery, (*c*) reflex spasm resulting from a lesion elsewhere in the gastrointestinal tract.

4. The duodenal stenoses do not belong to diseases of great rarity.

5. As to the therapeutics, the roentgen examination is decisive; it has to ascertain if there is an organic disease in question and if there exists a motor disorder both of which justify the intervention of the surgeon.

ESTIMATION OF CARDIAC AREA IN MAN

BY PAUL C. HODGES, M.D., AND J. A. E. EYSTER, M.D.

Department of Roentgenology, Peking Union Medical College, Peking, China, and the Physiological Laboratory, University of Wisconsin

MADISON, WISCONSIN

INTRODUCTION

RECOGNITION of the importance of accurate determination of heart size in relation to cardiac disease has led to a great deal of work in an effort to develop roentgen-ray methods as a supplement to the older methods of physical diagnosis. It is beyond the scope of the present communication to review in detail this large literature but reference may be made to the excellent articles by Moritz,[1] and Dietlen[2] and to the monographs of Groedel[3] and of Vaquez and Bordet.[4]

In order to avoid or reduce distortion, two methods in general have been employed—the distant roentgen-ray film or teleoroentgenogram, and the method of orthographic projection using only the incident ray, called the orthodiagram. Most of the work has been confined to the frontal plane of the cardiac silhouette. Various measurements of this silhouette have been made, but recent work has tended to emphasize two as of major importance, namely the area inclosed by the shadow, and its greatest transverse diameter. Recognizing the probability of variations of these measurements with other body measurements, attempts have been made to determine these relations, and most of the data that have been published include body weight and stature (height). The most extensive tables that have been presented for practical use are those of Bardeen.[5]

Most of the workers in cardiac roentgenology agree that when properly controlled, either teleoroentgenograms or orthodiagrams will give a reasonably accurate measurement of the frontal plane of the heart, in spite of the fact that by either method, the upper and lower borders of the cardiac silhouette must be completed empirically. Bardeen[5] has demonstrated this fact in cadavers and has also shown a close correspondence between frontal plane area and volume. Skavlem[6] has extended these observations to dogs. In the tables of Meek and Eyster[7] it is apparent that consecutive determinations made on the same animal check closely, and Eyster and Evans,[8] using the orthodiascope, find reasonable constancy of the ortho area in repeated examinations of the same man. Hodges[9] has published work to show that the teleo and ortho areas agree almost perfectly when made under identical conditions.

The use of roentgen rays is therefore clearly applicable to the study of the changes in heart size in a particular individual, and it is only when we come to the subject of absolute size that serious divergence of opinion exists. Some workers hold with Bertnard Smith[10] the view that the size of the human heart is delicately adjusted to stature and body weight. Others like Smith and Bloedorn[11] feel that individual variations are so great as to make the method entirely useless. Still others, among them Bardeen, feel that while certain variations from a mean size have to be considered, sufficient accuracy is obtained to be of practical value.

The present work represents an effort to establish, if possible, a closer standard of heart size with body measurements in normal subjects as a basis for practical use in clinical medicine. It involves the introduction of two paramount considerations, first, the use of a series of normal cases most carefully selected on the basis of the usual clinical and special cardiological methods of examination, and second, the application of statistical methods to the study of the data obtained.

It has seemed obvious to us that in choosing subjects for a normal series, selection should be made from a large, heterogeneous group and only after the most thorough examination by a competent cardiologist. The use of the statistical method of analysis has certain obvious advantages when applied to a biological

problem of this type. (1) Reasonably accurate conclusions can be drawn from a relatively small series, since the accuracy of the prediction is not in proportion to the absolute number of cases but to their square roots. (2) The relative weight of various influences can be evaluated. (3) Probabilities of accuracy of prediction can be stated in definite terms.

It is a common experience in biological work to find that a multitude of factors has more or less important effects on the characteristic or measurement being studied, and a work of this sort is no exception to the rule. For example, it is probable that the size of the heart varies with the mass of active body tissue, since it is the function of the heart as a muscle to supply these tissues with a certain amount of blood. On the other hand, the autonomic nervous system may vary heart rate and size, probably independently of circulatory requirements, and important physiological work in the past two decades has established a relationship between muscular activity and cardiac filling or diastolic heart size.

Many factors, like rate, may act only within certain ranges, and when these ranges have been studied and established it may be possible to rule them out by working within an inactive range. Other influences, like stature, may show straight line relationships, and in these, statistical weighing ought to be of the greatest value.

The factors studied in the present work are, heart rate, sitting height, stature, body weight and age. Certain of these we find can be eliminated, and from the remaining ones we have constructed a formula for the prediction of normal cardiac frontal plane area. Obviously many other factors remain to be considered, such, for example, as various thoracic measurements and the influence of sex and occupation. We hope to study some of these in subsequent work. The present effort must, therefore, be considered only as a beginning, but we believe it to be the start upon a path which must ultimately place us in a position to predict normal heart size with the least possible inaccuracy.

I. EFFECT OF PULSE RATE ON HEART SIZE

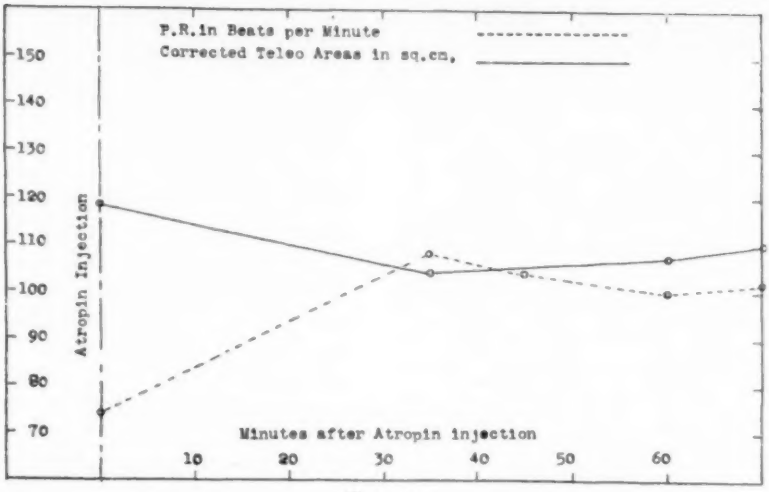
That diastolic heart size shows variations accompanying the changes in heart rate in muscular exertion has been shown by many workers. Under such conditions, however, variations in the amount of blood returned to the heart due to alterations in the peripheral blood vessels in the active muscles are at least in part responsible. This fact alone indicates the importance of carrying out normal heart size determinations under at least approximately basal conditions. It seems probable that during heart rate changes occurring under approximately basal conditions as a result of nervous influences acting through the extrinsic cardiac nerves, the size of the heart would tend to vary inversely as the rate in order to maintain a constant minute volume output. Meek,* working on dogs and producing heart rate changes by vagus stimulation and vagus paralysis with atropine, finds, however, that within a medium range, approximately 80 and 120 beats per minute, diastolic heart size tends to remain constant. With rates slower and faster than this the heart tends to show an inverse relationship. The present determinations represent an effort to obtain similar data from man.

Data. Young, normal, adult males and females were examined, teleos being made before and at frequent intervals after the subcutaneous administration of atropin. Some 20 cases were studied in all, but most of the earlier ones showed only very slight increases in pulse rate. Later, by greatly increasing atropin dosage, considerable range was obtained. The 9 cases for which we here present charts, received from a fortieth to a thirtieth of a grain of atropin sulphate in one injection and seemed to suffer no greater inconvenience from dryness of the throat than cases receiving smaller doses.

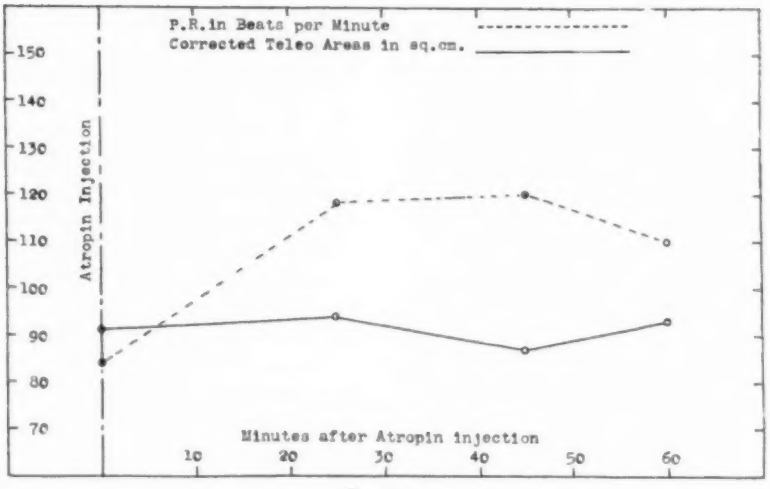
Discussion. Case 42 shows by far the most striking change of the series, cardiac area decreasing about 16 sq. cm. during an increase in pulse rate from 64 to 120 B.P.M.

In Cases 43, 14, 36, 44 and 45 there are decreases in area of from 6 to 11 sq. cm.

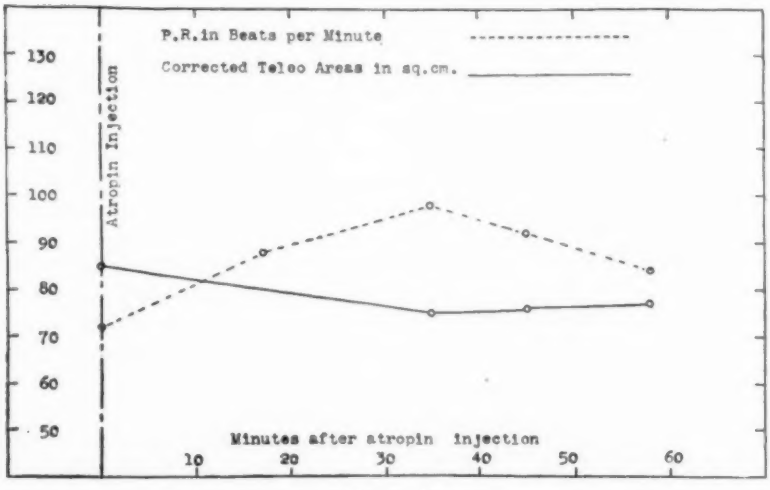
* Meek, Walter J. Personal communication. Work as yet unpublished.



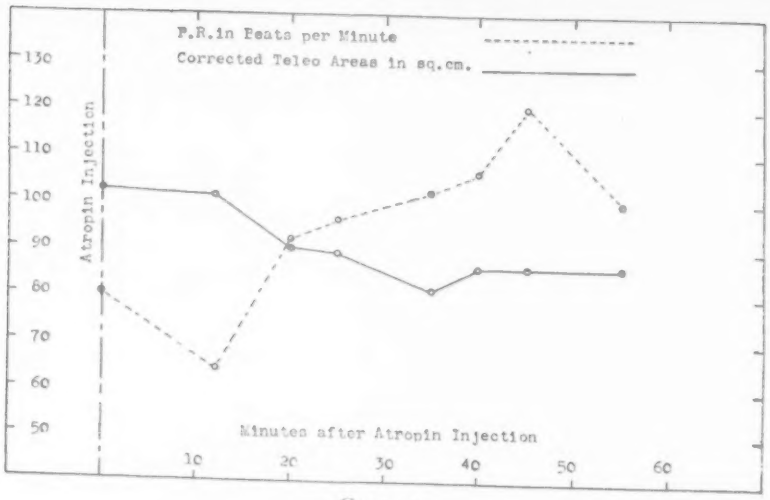
CASE 14.



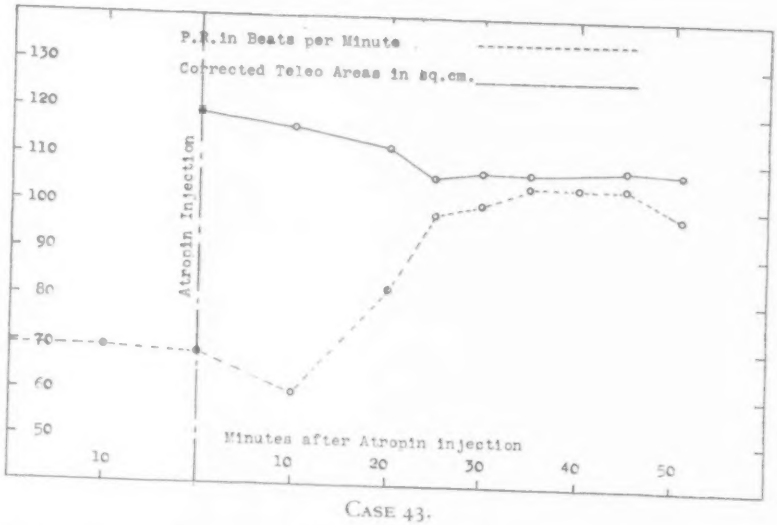
CASE 32.



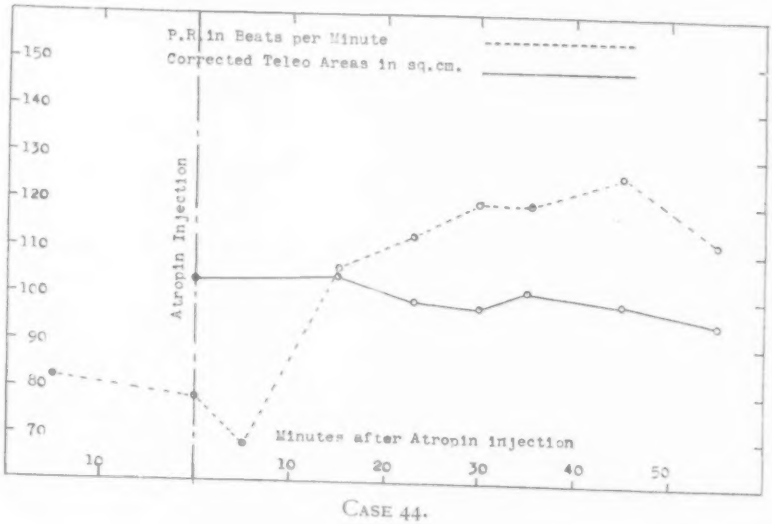
CASE 36.



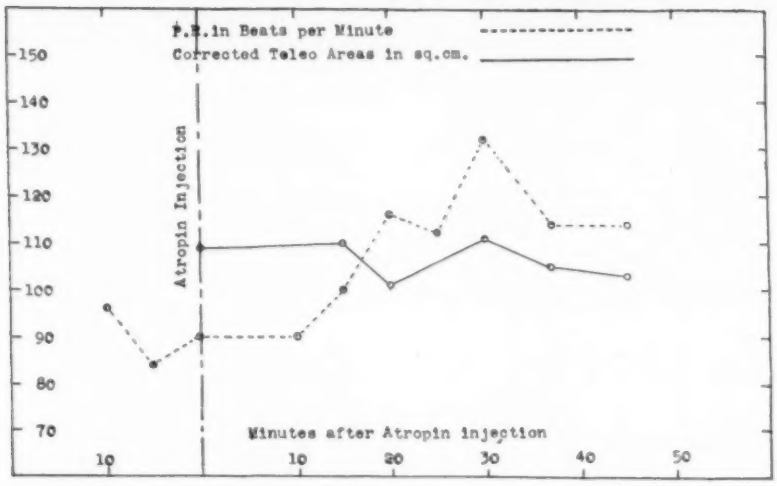
CASE 42.



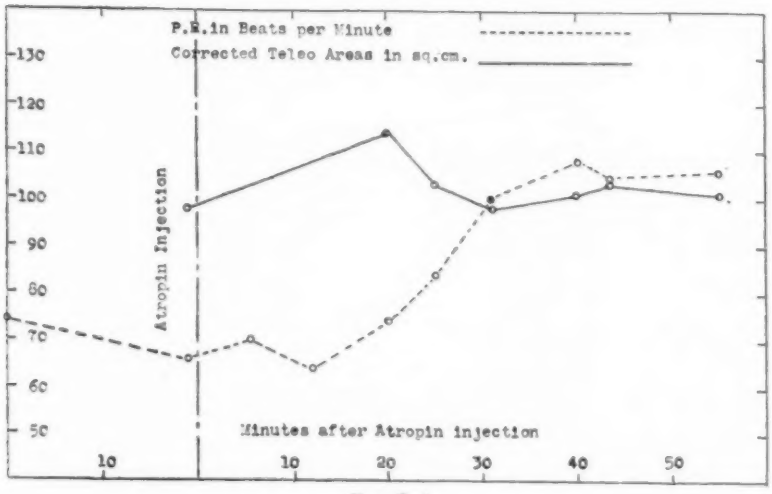
CASE 43.



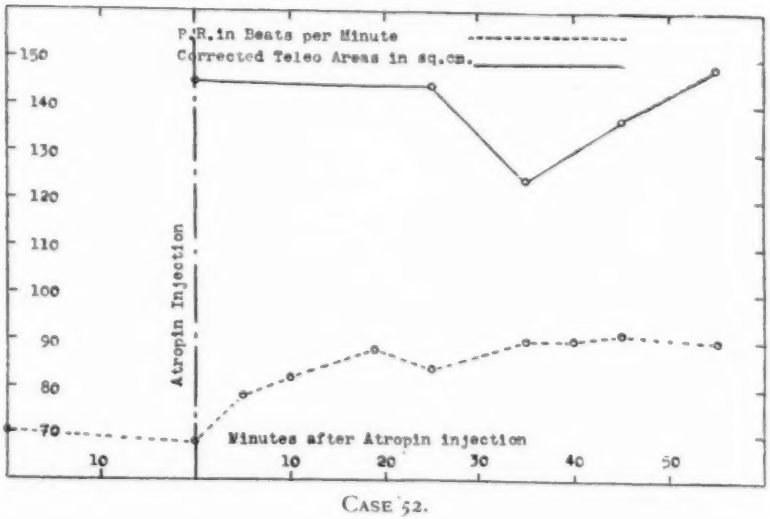
CASE 44.



CASE 45.



CASE 46.



CASE 52.

Three cases, 32, 46 and 52, show either no change or even a slight increase in heart size with increased rate.

Conclusions. Even from so small a series two conclusions may be safely drawn:

1. Heart size remains fairly constant for slight variations in pulse rate.

2. High rates are accompanied by some decrease in heart size, and in 1 case, out of a series of 9, the heart decreased 16 per cent in area for an increase in pulse rate from 64 to 120 B.P.M.

The second conclusion would seem to indicate the need of establishing the subject's normal pulse rate and then guarding against making the roentgen examination at a time when from excitement or some other cause the heart rate is particularly elevated.

II. THE RELATIVE VALUE OF SITTING HEIGHT AND STATURE IN PREDICTING NORMAL HEART SIZE

The worker searching for anthropological measurements or indexes to be used in predicting heart size must strive for a team of measurements correlating weakly with one another, but as strongly as possible with heart size. In any such team, stature will doubtless find a place. What other measurements will be used can only be shown by experiment. The following study was made on the chance that sitting height might correspond more closely with heart size than does stature. The supposition proves to be unsound, but experiment may show that some other measurement does hold the key to the situation.

TABLE 1

H = Stature in cm., subject without shoes
Si = Sitting height in cm.
T = Corrected teleo areas in sq. cm., subject breathing quietly and sitting erect

Case	T	H	Si	T^2	H^2	Si^2	T × Hi	T × Si
306	84	167	89	7056	27889	7921	14028	7476
307	89	163	85	7921	26569	7225	14507	7565
308	114	165	88	12996	27225	7744	18810	10032
309	90	160	87	8100	25600	7569	14400	7830
310	104	158	85	10816	24964	7225	16432	8840
311	97	154	83	9409	23716	6889	14938	8051
313	90	172	89	8100	29584	7921	15480	8010
314	77	159	84	5929	25281	7056	12243	6468
316	107	167	86	11449	27889	7396	17869	9202
317	102	153	83	10404	23409	6889	15606	8466
318	107	168	87	11449	28224	7569	17976	9309
319	103	172	93	10609	29584	8649	17716	9579
320	114	164	87	12996	26896	7569	18696	9918
322	103	161	85	10609	25921	7225	16583	8755
323	84	158	86	7056	24964	7396	13272	7224
A14	118	172	88	13924	29584	7744	20296	10384
324	96	165	86	9216	27225	7396	15840	8256
36	85	164	88	7225	26896	7744	13940	7480
40	77	153	79	5929	23409	6241	11781	6083
52	145	200	100	21025	40000	10000	29000	14500
46	110	179	94	12100	32041	8836	19690	10340
42	99	167	90	9801	27889	8100	16533	8910
43	133	181	94	17689	32761	8836	24073	12502
44	114	166	87	12996	27556	7569	18924	9918
45	124	176	91	15376	30976	8281	21824	11284
41	100	174	90	10000	30276	8100	17400	9000
Total.....	2666	4338	2284	280180	726328	201090	447857	235382
Mean.....	102.538	166.846	87.846	10776.153	27935.692	7734.23	17225.269	9053.153
Sigma.....	16.19	9.905	4.16					

$r_{TH} = 0.7309$ $r_{TSI} = 0.6919$

Data. Twenty-six normal adult males and females were used for the experiment, teleoroentgenograms being made with the subject sitting erect and breathing quietly. Heart silhouettes were completed by Bardeen's method,[5] measured with a planimeter and corrected for the known distortion of the particular apparatus used.[9] These corrected areas (designated T) together with the subject's stature and sitting height are listed in Table 1.

By following the regular procedure of squaring, multiplying etc., and by substituting means and standard deviations in Hull's modification of the Thurston Pearson formula,[13] we have 0.7309 as the correlation between stature and heart size, with 0.6919 in the case of sitting height.

Discussion. Since sitting height and stature have so nearly the same correlation with heart size, and since it is known that they correlate closely with one another, it follows that either measurement might be used in predicting heart size, but that nothing would be gained by using both.

III. THE PREDICTION OF NORMAL CARDIAC AREA FROM AGE, STATURE AND WEIGHT

The Thurston-Hull modification of Pearson's product-moment formula, together with the associated processes of partial correlation and prediction[14] supplies a statistical method capable of application to a wide range of physiological work in which the relations involved are of the straight line variety. Harris and Benedict's excellent work[15] on basal metabolism typifies the results that may be hoped for. In general, the result is to make clear, effects and relationships previously dimly understood.

The mathematical processes look more complicated than they really are, particularly to one who comes to them for the first time. With the growing tendency of medical students to include experimental psychology in their preclinical studies, it is to be hoped that more and more medical workers will come to their clinical work prepared to use statistical formulas as easily as they use the simpler formulas of chemistry. For those who have not had this preliminary training, the path of wisdom is to accept the guidance and assistance of their colleagues in psychology.

The enthusiastic cooperation which we have had from Professor Hull of the Department of Experimental Psychology at the University of Wisconsin is no doubt typical of what others may hope for elsewhere.

Selection of Subjects. Seventy adult males were used for the experiment, these being all of the definite normals in a series of several hundred mixed normal and pathological cases examined during the past few years in the cardiological service of one of us at the University of Wisconsin. Each subject was given a complete physical and cardiological examination and none was admitted to the list if history, symptoms, or physical findings gave any hint of cardiac disease.

Orthodiagram tracings had been made from these subjects at the time of their examinations, and these tracings were now completed and their areas measured with a planimeter. These areas in sq. cm., together with the subject's age in years to nearest birthday, stature in cm. without shoes, and weight in kg. without coat or shoes, constitute our data.

Treatment of Data. In view of the fact that we hope to extend our work later to include the study of many other factors possibly affecting cardiac area, we have felt it worth while to include in this first communication a rather detailed sketch of the statistical method we are using. In general, it follows the plan adopted by Harris and Benedict but there are occasional changes in formulas; which have been adopted in the Department of Experimental Psychology at the University of Wisconsin.[16]

Table II lists the individual measurements of age (A), stature (H), weight (W), and cardiac area (O). We are primarily interested in area (O) and so in statistical language O is the criterion of our problem and A, H and W are the variables. The means of these measurements we find to be:

Mean age (M_A) = 31.271
Mean stature (M_H) = 175.543
Mean weight (M_W) = 69.286
Mean area (M_O) = 112.343

TABLE II

A = Age in years to nearest birthday.
H = Stature in cm., subjects without shoes.
W = Weight in kg., subjects without shoes or coat.
O = Observed orthodiagram areas in sq. cm.
P = Cardiac areas calculated from prediction formula.
T = Cardiac areas calculated from Bardeen tables.
T.D. = Transverse diameters of observed ortho tracings.

Case	A	H	W	O	P	T	T.D.
A	50	183	77	143	122	137	135
B	37	192	77	143	129	141	127
411	30	180	70	118	116	128	125
412	30	175	72	101	113	127	109
408	34	170	53	91	102	112	97
432	26	175	73	119	106	125	130
406	28	185	60	93	117	122	108
427	26	175	66	106	111	121	113
C	47	182	82	124	123	136	124
D	33	178	67	105	114	123	110
E	34	173	64	119	108	119	126
F	27	175	72	113	113	125	125
G	24	159	55	103	93	107	120
H	28	175	74	115	113	125	129
I	29	178	75	129	116	127	139
J	34	185	98	123	130	147	142
K	45	171	79	113	112	127	134
L	33	179	66	112	114	124	127
M	34	179	86	132	121	135	147
N	33	179	70	139	116	127	136
450	29	180	84	96	121	133	126
452	31	180	68	115	116	127	117
457	34	173	64	135	108	121	132
261	43	183	84	122	124	137	125
258	25	180	68	107	116	125	110
448	26	170	60	119	104	114	121
251	34	175	76	112	114	149	116
445	27	173	70	113	110	122	115
444	27	185	78	126	123	133	113
446	26	173	64	110	108	119	120
456	28	173	61	102	107	116	105
440	32	173	64	108	108	120	112
438	33	183	73	102	120	131	113
433	31	180	83	121	121	134	142
403	23	175	64	125	110	119	115
356	27	178	73	113	116	126	136
P	20	179	62	115	113	119	115
287	24	185	68	17	120	127	126
48	33	165	60	106	100	115	122
415	33	168	68	100	105	120	131
443	28	168	54	98	101	110	107
447	30	178	64	107	113	123	114
442	28	178	62	102	112	119	112
441	33	173	57	93	106	116	108
338	30	170	67	92	107	121	115
407	29	178	62	115	112	117	113
436	30	173	77	108	113	128	131
434	28	168	55	99	101	110	115
130	32	170	70	104	108	113	115
431	25	173	68	118	115	121	134
420	29	178	73	120	116	126	137
424	23	163	56	92	97	109	115
352	27	178	68	113	114	123	114
425	31	170	75	103	109	126	107
428	35	175	79	128	115	130	140
405	25	183	73	106	117	122	114
454	28	175	64	91	110	120	105
321	32	168	64	117	104	118	117
417	28	178	75	117	116	127	130
58	30	168	67	104	105	120	122
378	32	173	67	110	109	123	113
413	28	175	68	105	111	122	114
358	30	178	70	123	115	126	128
46	52	178	79	126	118	134	140
459	19	173	66	118	109	119	119
422	46	168	72	82	107	123	107
423	59	170	57	117	104	117	129
R	30	163	61	103	99	113	121
S	37	192	77	143	129	139	127
T	27	174	85	105	116	131	132
Total...	2189	12288	4850	7864	7861	8698	8510
Mean...	31.271	175.543	69.286	112.343	112.3	124.257	121.571

TABLE III

O = Orthodiagram area in sq. cm.
A = Age in years to nearest birthday.

Case	O	O^2	A	A^2	O × A
A	143	20449	50	2500	7150
B	143	20449	37	1369	5291
411	118	13924	30	900	3540
412	101	10201	30	900	3030
408	91	8281	34	1156	3094
432	119	14161	26	676	3094
406	93	8649	28	784	2604
427	106	11236	26	676	2756
C	124	15376	47	2209	5828
D	105	11025	33	1089	3465
E	119	14161	34	1156	4046
F	113	12769	27	729	3051
G	103	10609	24	576	2472
H	115	13225	28	784	3220
I	129	16641	29	841	3741
J	123	15129	34	1156	4182
K	113	12769	45	2025	5085
L	112	12544	33	1089	3696
M	132	17424	34	1156	4488
N	139	19321	33	1089	4587
450	96	9216	29	841	2784
452	115	13225	31	961	3656
457	135	18225	34	1156	4590
261	122	14884	43	1849	5246
258	107	11449	25	625	2675
448	119	14161	26	676	3094
251	112	12544	34	1156	3808
445	113	12769	27	729	3051
444	126	15876	27	729	3402
446	110	12100	26	676	2860
456	102	10404	28	784	2856
440	108	11664	32	1024	3456
438	102	10404	33	1089	3366
433	121	14641	31	961	3751
403	125	15625	23	529	2875
356	113	12769	27	729	3051
P	115	13225	20	400	2300
287	117	13689	24	576	2808
48	106	11236	33	1089	3498
415	100	10000	33	1089	3300
443	98	9604	28	784	2744
447	107	11449	30	900	3210
442	102	10404	28	784	2856
441	93	8649	33	1089	3069
338	92	8464	30	900	2760
407	115	13225	29	841	3335
436	108	11664	30	900	3240
434	99	9801	28	784	2772
130	104	10816	32	1024	3328
431	118	13924	25	625	2950
420	120	14400	29	841	3480
424	92	8464	23	529	2116
352	113	12769	27	729	3051
425	103	10609	31	961	3193
428	128	16384	35	1225	4480
405	106	11236	25	625	2650
454	91	8281	28	784	2548
321	117	13689	32	1024	3744
417	117	13689	28	784	3276
58	104	10816	30	900	3120
378	110	12100	32	1024	3520
413	105	11025	28	784	2940
358	123	15129	30	900	3690
46	126	15876	52	2704	6552
459	118	13924	19	361	2242
422	82	6724	46	2116	3772
423	117	13689	59	3481	6903
R	103	10609	30	900	3090
S	143	20449	37	1369	5291
T	105	11025	27	729	2835
Total.....	7864	895336	2189	71929	246713
Mean.....	112.343	12790.514	31.271	1027.557	3524.471
Sigma.....	13.02	.....	7.05		

$r_{OA} = 0.1241$

Zero Order Correlation Coefficients. The coefficient of the correlation of age (A) with cardiac area (O) is written r_{OA} and is called a zero order coefficient because it involves the criterion and only one of the variables, none of the others being considered. The first step in determining the value of this coefficient is to prepare a new table (see Table III) consisting of five columns in which are listed the O and A measurements, their squares (O^2) and (A^2) and the product of cardiac area multiplied by age ($O \times A$) for each of the 70 cases. By adding each column and dividing the totals by 70 we have;

Mean cardiac area (M_o) = 112.343
Mean of the squares of cardiac areas (M_o^2) = 12790.514
Mean age (M_A) = 31.271
Mean of the squares of the ages (M_A^2) = 1027.557
Mean of the products of area multiplied by age ($M_{o\times A}$) = 3524.471

These values can now be substituted in the Thurston-Hull modification of Pearson's product-moment formula which is written as follows.

$$r_{OA} = \frac{M_{o\times A} - (M_o \times M_A)}{\sqrt{M_o^2 - M^2_o} \times \sqrt{M_A^2 - M^2_A}}$$

$\sqrt{M_o^2 - M^2_o}$ is read,

"The square root of the mean of the squares of O minus the square of the mean of the O's." This is the expression for the standard deviation or sigma of O and so the correlation formula might also be written,

$$r_{\overline{OA}} = \frac{M_{o\times A} - (M_o \times M_A)}{\text{Sigma}_o \times \text{Sigma}_A)}$$

Solving the equation we have $r_{\overline{OA}} = 0.1241$ and repeating the process for the other variables we have the following array:

$r_{OA} = 0.1241$ $r_{WA} = 0.2848$
$r_{OH} = 0.5337$ $r_{WH} = 0.5266$
$r_{OW} = 0.4533$ $r_{HA} = 0.1116$

First Order Partial Correlation Coefficients. Useful as they are in showing relationships between the various factors influencing cardiac area, these zero order coefficients have still greater value when used as stepping stones to partial correlations in which we are able to determine the effect of each of the variables upon the criterion (in this case O) uninfluenced by the effect of the other two. Correlations in which one factor is eliminated or held constant are called first order coefficients, those with two factors held constant are second order coefficients, and so on. Having in this problem three variables, we must eventually compute second order coefficients, and since higher orders are computed from the values of the next lower order our second preliminary step must be the computation of first order coefficients.

This we do from the formula,

$$r_{OA.H} = \frac{r_{OA} - (r_{OH} \times r_{AH})}{\sqrt{1 - r^2_{OH}} \times \sqrt{1 - r^2_{AH}}}$$

which is read

"The correlation of A with O when H is constant is equal to the coefficient of correlation between A and O, minus the product of the coefficient for O and H multiplied by the coefficient of A and H; divided by the product of the square root of one minus the square of the coefficient of O and H multiplied by the square root of one minus the square of the coefficient of A and H."

By rewriting the equation for the various combinations of variables and criterion and substituting the necessary values, we obtain the following first order coefficients.

$r_{OA.H} = 0.076$ $r_{OW.H} = 0.239$
$r_{OA.W} = -0.006$ $r_{AH.O} = 0.066$
$r_{OH.A} = 0.53$ $r_{WA.H} = 0.267$
$r_{OH.W} = 0.401$ $r_{HW.A} = 0.519$
$r_{OW.A} = 0.439$

Second Order Partial Correlation Coefficients. The formula for computing second order coefficients from lower orders is as follows:

$$r_{OA.HW} = \frac{r_{OA.W} - (r_{OH.W} \times r_{AH.W})}{\sqrt{1 - R^2_{OH.W}} \times \sqrt{1 - r^2_{AH.W}}}$$

It is read :"The correlation between O and A with H and W held constant is equal to " etc.

Rewriting for the other combinations and making the numerical substitutions

$r_{OA.HW} = 0.013$ $r_{AW.HO} = 0.257$
$r_{OH.AW} = 0.394$ $r_{HW.OA} = 0.376$
$r_{OW.HA} = 0.246$

Standard Deviations. Instead of using average deviations of a measurement from its mean, the statistician used the standard deviation or Sigma. This may be defined as the square root of the mean of the squares of the individual deviations. One of the particular advantages of the Hull-Thurston modification of Pearson's formula lies in the fact that Sigmas of the various measurements under consideration are developed in the denominator of the equation at the time of the determination of the zero order correlation coefficients. We have, therefore, already determined the following standard deviations or Sigmas.

S. D. or Sigma_O = 13.02
" or Sigma_A = 7.05
" or Sigma_H = 6.20
" or Sigma_W = 8.65

Partial Standard Deviation. In addition to simple or zero order standard deviations like $S.D._O$ we need for our regression equation partial or higher order standard deviations like $S.D._{O.AHW}$. For the meaning of this form one may refer to such texts as Yule,[17] and as far as this paper is concerned we need only know that it is an expression necessary in the regression equation, and that it is derived from the formula:

$$S.D._{O.AHW} = S.D._O\sqrt{1 - r^2_{OA}} \times \sqrt{1 - r^2_{OH.A}} \times \sqrt{1 - r^2_{OW.HA}}$$

Rearranging the formula for the various combinations of variables and criterion and substituting the necessary values we have the following partial standard deviations.

$S.D._{O.AHW}$ = 10.63
$S.D._{A.OHW}$ = 6.76
$S.D._{H.AOW}$ = 4.84
$S.D._{W.AHO}$ = 7.75

The Prediction Formula. We now have available all of the values needed for the prediction formula or regression equation which is written as follows:

$$x_O = r_{OA.HW}\frac{S.D._{O.AHW}}{S.D._{A.OHW}}x_A + r_{OH.AW}\frac{S.D._{O.AHW}}{S.D._{H.OWA}}x_H + r_{OW.AH}\frac{S.D._{O.AHW}}{S.D._{W.OAH}}x_W$$

Where

x_O = deviation of predicted O from mean O
x_A = " " measured A " " A
x_H = " " " H " " H
x_W = " " " W " " W

Substituting our values for the partial correlations and partial standard deviations and clearing and collecting the equation we obtain:

$$x_O = 0.0204\ x_A + 0.8668\ x_H + 0.377\ x_W$$

This may also be written,

$$X_O - M'_O = 0.0204\ (X_A - M_A) + 8668\ (X_H - M_H) + 0.337\ (X_W - M_W)$$

Where,

$X_O - M_O$ = predicted area minus mean area or x_O
$X_A - M_A$ = measured age minus mean age or x_A
$X_H - M_H$ = measured stature minus mean stature or x_H
$X_W - M_W$ = measured weight minus mean weight or x_W

Substituting these values and again clearing and collecting we have finally, $X_O = 0.0204\ X_A + 0.8668\ X_H + 0.337\ X_W - 63.8049$ which may be read,

"Predicted heart area in sq. cm. is equal to the measurement of age in years multiplied by the factor 0.0204 plus the measurement of stature in cm. multiplied by the factor 0.8668 plus the measurement of weight in kg. multiplied by the factor 0.337, minus the constant 63.8049."

Validity of the Prediction. To test in advance the accuracy with which an equation built on measurements of age, stature and weight will predict cardiac area, we may use the following formula:

$$1\text{-}R^2_{O.AHW} = (1\text{-}r^2_{OW})\ (1\text{-}r^2_{OH.W})\ (1\text{-}r^2_{OA.WH})$$

Substituting the data from our experiments and solving we have $R_{O.AHW}$ = 0.578 which may be read,

"The accuracy of the prediction (R) of cardiac area (O) when age (A), stature (H) and weight (W) are given their optimum weight is equal to 0.578 by the Pearsonian system of coefficients."

This means that if we were to predict the cardiac area of our 70 subjects and then compare the predictions with the actual measurements, the two would have a correlation of 0.578. We shall see in a

moment how this factor can be used for a very important purpose.

If we were compelled to guess the individual cardiac areas of each of our 70 cases the best plan would be to guess for each, the average area of the group, irrespective of variations in age, stature and weight. In such guessing there would, of course, be a probable error, called the probable error of distribution. We may calculate this from the following formula:

$P.E._{Dis.}$ = A constant (0.6745) multiplied by $S.D._o$

Substituting the Sigma of o (13.02) and solving we have,

$P.E._{Dis.}$ = 8.78 sq. cm. This means that half our guesses would be correct within plus or minus 8.78 sq. cm., and of the remainder, half would be more than 8.78 sq. cm. too large, half more than 8.78 sq. cm. too small. Our prediction formula, however, with its coefficient R of 0.578 provides a better method than guessing and its exact numerical advantage may be shown by computing the probable error of estimate.

$P.E._{Est.}$ = $P.E._{Dis.}$ multiplied by $(1-R^2)$ or, substituting the values,

$P.E._{Est.}$ = 7.15 or for practical purposes $P.E._{Dis.}$ = 7 sq. cm.

Thorndike's tables[18] based on a theoretical population of 10,000 show the results that may be expected in making predictions of cardiac area from a formula whose probable error of estimate is 7 sq. cm. If we were able to gather a population of 10,000 subjects, each of such age, weight and stature as to predict a cardiac area of 100 sq. cm., actual measurement would show 5000 hearts between 93 sq. cm. and 107 sq. cm.; 2500 hearts larger than 107 sq. cm.; and 2500 hearts smaller than 93 sq. cm. Three-fourths of the cases, therefore, would not exceed 100 sq. cm. by more than 7 cm., or conversely, the odds would be three to one against a normal subject having a measured cardiac area more than 7 sq. cm. larger than his predicted area.

To express this in clinical terms we may say: "With an observed cardiac area 7 sq. cm. (actually 7.15) larger than the area predicted from age, stature and weight, the odds are three to one in favor of pathology.

Referring again to Thorndike's tables, we find that 887 of the 10,000 cases will be larger than 114 sq. cm., and 215 will have areas larger than 121 sq. cm. Clinically this means that with observed areas 14 sq. cm. and 21 sq. cm. larger than the predicted area, the chances are respectively 10 to 1 and 45 to 1 in favor of pathology.

Practical Application of the Method. We must test our formula by using it to predict the areas of the 70 normal cases and for the sake of comparison let us also compute the areas from the Bardeen tables.[19] This we do, listing the data in Table 11 where P represents areas calculated by the prediction formula and T areas calculated from the Bardeen tables. (T.D. represents transverse diameters which were measured and recorded but not used in this particular problem.) The next step is to correlate each of the predicted scores with the measured areas, and doing this we have,

From prediction formula	From Bardeen tables
$S.D._P$ = 7.4	$S.D._T$ = 8.25
r_{OP} = 0.565	r_{OT} = 0.533

The fact that the calculated correlation between predicted scores and actual scores was 0.578 whereas the actual correlation is 0.565 is doubtless due to the fact that we have dropped decimals in order to have the expressions for area in whole numbers.

Graphic Representation. Figure 1 is a graph of the values of O and T from Table 1, the observed areas being plotted as ordinates, with calculated areas as abscissas. The solid lines HI and JK mark the mean values of observed and predicted areas respectively. The broken line CD indicates the position that would be taken by the coordinate points if every observed area were indentical with the corresponding prediction. Such a condition would yield identical means for O and T and a correlation factor of 1. CD, therefore, is drawn with the angle CYJ equal to 45 degrees (because 1 is the tangent of 45 degrees) and at such a level that it cuts identical points on the two scales (because the two means are identical). EF shows how the points would lie if there were perfect correlation but every pair of values having the same mutual relation as the means, that is, in the ratio of O 112 to T

124. AB is calculated from the points as they lie, that is, it is the extension of the side AX of the angle AXJ which was constructed 28 degrees 10 min. because that is the angle whose tangent comes nearest to 0.533, the correlation between O and T.

Points lying above or to the right of CD indicate cases in which predicted area is larger than observed area. Points to the

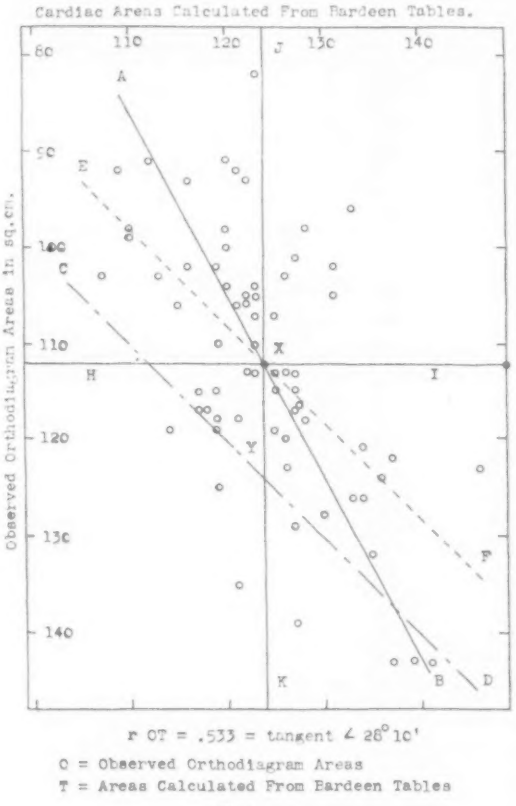

Cardiac Areas Calculated From Bardeen Tables.
Observed Orthodiagram Areas in sq.cm.
r OT = .533 = tangent ∠ 28° 10'
O = Observed Orthodiagram Areas
T = Areas Calculated From Bardeen Tables

FIG. 1.

left of CD show observed areas larger than predications. It is obvious, therefore, that in the large majority of these particular cases predictions from the Bardeen tables tend to be too large. As most of the subjects used in the Bardeen tables were probably examined in inspiration and leaning forward this may account for the overprediction, for we have already shown[9] that teleoroentgenograms made with that technique give areas roughly 10 per cent larger than those made with the subject erect and breathing quietly.

Figure 11 is a graph of the values of O and P, and here we see slightly better correlation of the predicted area with the observed area, as indicated by the slightly larger angle AXJ, together with coinciding of CD and EF as a result of identical means. The accuracy of our formula in predicting areas identical with the measured areas is therefore, somewhat greater than the accuracy of the older tables in predicting areas 12 cm. too large.

Use of the Tables. Until now we have been using the complete formula in predict-

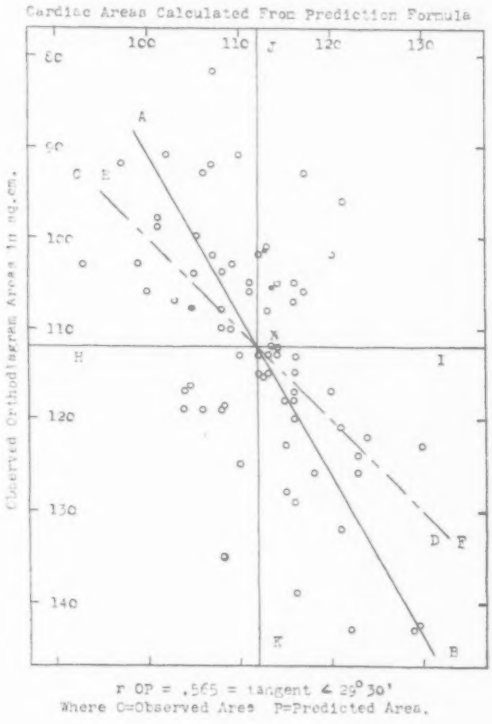

Cardiac Areas Calculated From Prediction Formula
Observed Orthodiagram Areas in sq.cm.
r OP = .565 = tangent ∠ 29° 30'
Where O=Observed Area P=Predicted Area.

FIG. 2.

ing areas because for the purpose of checking the correlation, every factor had to be taken into consideration. A glance at the formula shows however, that the weighted effect of age in determining area is so slight that it may well be ignored. For instance in a subject twenty years old, age multiplied by its factor adds only 0.4 sq. cm. to the area as predicted from stature and weight and only when we reach 50 does the value amount to 1 sq. cm. Two tables will serve, therefore, in place of the formula, the one a table in which 63.80 has been subtracted

STATURE IN CM. × 0.87 MINUS 63.80

Stature in centimeters	Cardiac area in square centimeters
150	66.70
151	67.57
152	68.44
153	69.31
154	70.18
155	71.05
156	71.92
157	72.79
158	73.66
159	74.53
160	75.40
161	76.27
162	77.14
163	78.01
164	78.88
165	79.75
166	80.62
167	81.49
168	82.36
169	83.23
170	84.10
171	84.97
172	85.84
173	86.71
174	87.58
175	88.45
176	89.32
177	90.19
178	91.06
179	91.93
180	92.80
181	93.67
182	94.54
183	95.41
184	96.28
185	97.15
186	98.02
187	98.89
188	99.76
189	100.63
190	101.50
191	102.37
192	103.24
193	104.11
194	104.98
195	105.85
196	106.72
197	107.59
198	108.46
199	109.39
200	110.20

WEIGHT IN KG. × 0.34

Weight in kilograms	Cardiac area in square centimeters
50	17.00
51	17.34
52	17.68
53	18.02
54	18.36
55	18.70
56	19.04
57	19.38
58	19.72
59	20.06
60	20.40
61	20.74
62	21.08
63	21.42
64	21.76
65	22.10
66	22.44
67	22.78
68	23.12
69	23.46
70	23.80
71	24.14
72	24.48
73	24.82
74	25.16
75	25.50
76	25.84
77	26.18
78	26.52
79	26.86
80	27.20
81	27.54
82	27.88
83	28.22
84	28.56
85	28.90
86	29.24
87	29.58
88	29.92
89	30.26
90	30.60
91	30.94
92	31.28
93	31.62
94	31.96
95	32.30
96	32.64
97	32.98
98	33.32
99	33.66
100	34.00
101	34.34
102	34.68
103	35.02
104	35.36
105	35.70

from the products of 0.87 multiplied by statures from 150 to 200 cm.; the second a table of the products of 0.34 mutiplied by weights from 50 to 105 kg. To use them one merely reads in the stature table the value for his subject's stature, and in the weight table the value for his weight, adds the two, and if his subject is over 45 years old adds another sq. cm. The represents the prediction of the subject's cardiac area.

Example. We have a subject 52 years old, 178 cm. tall and weighing 79 kg. His completed teleoroentgenogram, made with the subject sitting erect and breathing quietly, is measured with a planimeter and found to have an area of 126 sq. cm. after correction for the distortion due to divergence of the rays. Is the heart normal, or enlarged?

Looking in the stature column we find 91.06 as the value for his stature and in the weight table 26.86 as the value for his

weight. These two values we add together and then add one more square centimeter because the subject is over 45 years old. The total, 118.92, or in round figures, 119 sq. cm. is the predicted area of his heart.

Our measured area of 126 is 7 sq. cm. larger than the prediction, and therefore the odds are about three to one in favor of some enlargement. On the other hand, one normal heart in three would be this large anyway.

Discussion. It is inevitable that our formula, built on these particular 70 cases, should give the best possible predictions for the same cases. The mathematics used insure this. On the other hand, it is rational to assume that in predicting for new cases this formula, weighing the variables jointly, will be more accurate than tables which ignore one factor during the consideration of another.

Strictly speaking the formula should be used only for males, though practically Bardeen finds very little difference between the sexes.

Further work may show that a special formula will have to be built for children.

SUMMARY

New tables are given for the estimation of normal cardiac area in man. These are derived from the formula:

Area in sq. cm. = Age 0.0204 + Stature 0.8668 + Weight 0.337 minus the constant 63.8049.

If the heart is found to be 7 sq. cm. larger than the predicted area chances are 3 to 1 that it is actually enlarged. With 14 sq. cm. the chances of pathology are 10 to 1 and with 21 sq. cm., 45 to 1.

BIBLIOGRAPHY

1. Moritz, F. Ueber Veränderungen in der Form, Grösse und Lage des Herzens beim Uebergang aus horizontaler in vertikale Körperstellung; zugleich ein zweiter Beitrag zur Methodik der Orthodiagraphie, insbesondere zu der Frage, wie die Orthodiagramme auszumessen seien und welche Körperstellung für die Orthodiagraphie des Herzens zu wählen sei. *Deutsches Arch. f. klin. Med., Leipz.*, 1904–05, lxxxii, 1–40.
2. Dietlen, H. *Deutsches Arch. f. klin. Med., Leipz.*, 1907, lxxxviii, 55.
3. Groedel, F. M. Die Röntgendiagnostik der Herz- und Gefässerkrankungen. H. Muesser, Berlin, 1912.
4. Vaquez, H., and Bordet, E. The Heart and the Aorta. Translated from the French by Honeij and Macy. Yale University Press, 1920.
5. Bardeen, C. R. Determination of the size of the heart by means of the *x*-rays. *Am. J. Anat., Phila.*, 1918, xxiii, 423–487.
6. Skavlem, J. H. Estimation of cardiac volume in the living animal by means of the teleroentgenogram. *Am. J. Physiol., Balt.*, 1922, lxi, 501–504.
7. Meek, W. J. and Eyster, J. A. E. The effect of plethora and variations in venous pressure on diastolic size and output of the heart. *Am. J. Physiol., Balt.*, 1922, lxi, 186–202.
8. Eyster, J. A. E. and Evans, J. S. Transactions American Physicians, 1923.
9. Hodges, Paul C. A comparison of the teleoroentgenogram with the orthodiagram. Am. J. Roentgenol. & Rad. Therap., 1924, xi, 466–474.
10. Smith, Bertnard. Teleroentgen measurements of the hearts of normal soldiers. *Arch. Int. Med.*, 1920, xxv, 522–536.
11. Smith, H. W., and Bloedorn, W. A. The size of the normal heart, a teleoroentgen study. *U. States Nav. M. Bull., Wash.*, 1922, xvi, 219–239.
12. Crelle, A. L. Calculating Tables. Seeliger, 1919.
13. Barlow's Tables, A. De Morgan, Edit., 1921.
14. Pearson, Karl. Tables for Statisticians and Biometricians. Cambridge University Press, 1914.
15. Harris, J. Arthur, and Benedict, Francis G. A Biometric Study of Basal Metabolism in Man. Carnegie Institution, Washington, 1919.
16. Hull, Clark L. *J. Applied Psychol.*, 1923, vii, 277.
17. Yule, G. U. An Introduction to the Theory of Statistics. Chas. Griffen, London, 1919.
18. Thorndike, Edward L. An Introduction to the Theory of Mental and Social Measurements. Columbia University Press.
19. United States Army *X*-Ray Manual. Paul B. Hoeber, New York, 1920.

THE AMERICAN ROENTGEN RAY SOCIETY

President: HOLLIS E. POTTER, M.D., 122 South Michigan Ave., Chicago, Ill.; *President-Elect:* GEORGE W. HOLMES, M.D., Massachusetts General Hospital, Boston, Mass.; *First Vice-President:* F. M. LAW, M.D., New York City; *Second Vice-President:* E. C. SAMUEL, M.D., New Orleans, La.; *Secretary:* W. W. WATKINS, M.D., Phoenix, Ariz.; *Treasurer:* W. A. EVANS, M.D., 10 Petersboro St., Detroit, Mich.; *Librarian and Historian:* H. W. DACHTLER, 224 Michigan St., Toledo, O.

Executive Council: W. F. MANGES, M.D., Chairman, Philadelphia, Pa., A. H. PIRIE, M.D., Montreal, Canada, H. M. IMBODEN, M.D., New York City, H. E. POTTER, M.D., Chicago, Ill., G. W. HOLMES, M.D., Boston, Mass., A. C. CHRISTIE, M.D., Washington, D. C., W. W. WATKINS, M.D., Phoenix, Ariz., W. A. EVANS, M.D., Detroit, Mich., CHARLES EASTMOND, M.D., Brooklyn, N. Y., B. R. KIRKLIN, M.D., Muncie, Ind., M. P. BURNHAM, M.D., San Francisco, Calif.

Committee on Laws and Public Policy: BUNDY ALLEN, M.D., Chairman, Iowa City, Ia., B. R. KIRKLIN, M.D., Muncie, Ind., THOMAS BURCHAM, M.D., Des Moines, Ia.

Safety Committee: H. K. PANCOAST, M.D., Chairman, Philadelphia, Pa., P. M. HICKEY, M.D., Ann Arbor, Mich., JOHN T. MURPHY, M.D., Toledo, O., W. D. COOLIDGE, PH.D., Schenectady, N. Y., WM. DUANE, PH.D., Boston, Mass., B. H. NICHOLS, M.D., Cleveland, O.

Leonard Prize Committee: G. W. GRIER, M.D., Chairman, Pittsburgh, Pa., F. M. LAW, M.D., New York City, G. E. RICHARDS, M.D., Toronto, Canada.

Publication Committee: W. F. MANGES, M.D., Chairman, Philadelphia, Pa., H. E. POTTER, M.D., Chicago, Ill., W. W. WATKINS, M.D., Phoenix, Ariz.

Member of the National Research Council: P. M. HICKEY, M.D., Ann Arbor, Mich.

Editor: ARTHUR C. CHRISTIE, M.D., 1909 Massachusetts Ave., N. W., Washington, D. C.

Editorial Board: JAMES T. CASE, M.D., H. K. PANCOAST, M.D., WILLIAM DUANE, PH.D.

Associate Editors: CHARLES EASTMOND, M.D., D. Y. KEITH, M.D., ROY A. PAYNE, M.D.

Advisory Board for Pathology: JAMES EWING, M.D., EUGENE OPIE, M.D., A. S. WARTHIN, M.D.

Publishers: PAUL B. HOEBER, Inc., 67–69 East 59th St., New York City.

Twenty-Sixth Annual Meeting: To be Announced.

SECTIONS OF THE AMERICAN ROENTGEN RAY SOCIETY

EASTERN SECTION: CHARLES EASTMOND, M.D., Chairman, Brooklyn, N. Y., RALPH LEONARD, M.D., Vice-Chairman, Boston, Mass., F. M. Hodges, M.D., Secretary, Richmond, Va.

CENTRAL SECTION: B. R. KIRKLIN, M.D., Chairman, Muncie, Ind., JOHN T. MURPHY, M.D., First Vice-Chairman, Toledo, O., GEO. F. THOMAS, M.D., Second Vice-Chairman, Cleveland, O., WM. A. EVANS, M.D., Secretary, Detroit, Mich.

Sixth Annual Meeting: AT DETROIT, MICH., February 20 and 21, 1925.

WESTERN SECTION: M. P. BURNHAM, M.D., Chairman, San Francisco, Calif., F. C. SWEARINGEN, M.D., Vice-Chairman, Pomona, Calif., ROY A. PAYNE, M.D., Sec'y, Portland, Ore.

THE AMERICAN RADIUM SOCIETY

President: WILLIAM S. NEWCOMET, M.D., 3501 Baring St., Philadelphia, Pa.; *President-Elect:* DOUGLAS QUICK, M.D., New York City; *First Vice-President:* ALBERT SOILAND, M.D., Los Angeles, Calif.; *Second Vice-President:* ERNEST C. SAMUEL, M.D., New Orleans, La.; *Secretary:* EDWIN C. ERNST, M.D., St. Louis, Mo.; *Treasurer:* ROBERT E. LOUCKS, M.D., Detroit, Mich.

Executive Committee: GEORGE E. PFAHLER, M.D., Chairman, Philadelphia, Pa., ROBERT E. LOUCKS, M.D., Detroit, Mich., JAMES T. CASE, M.D., Battle Creek, Mich.

Program Committee: DOUGLAS QUICK, M.D., Chairman, New York City, LEDA J. STACY, M.D., Rochester, Minn., HARVEY W. VAN ALLEN, M.D., Springfield, Mass.

Membership Committee: SANFORD B. WITHERS, M.D., Chairman, Denver, Colo., ISAAC GERBER, M.D., Providence, R. I., B. R. KIRKENDALL, M.D., Columbus, Ohio.

Publication Committee: HENRY K. PANCOAST, M.D., Chairman, Philadelphia, Pa., G. FAILLA, PH.D., New York City, EDWIN C. ERNST, M.D., St. Louis, Mo.

Standardization Committee: WM. DUANE, PH.D., Chairman, Boston, Mass., HENRY SCHMITZ, M.D., Chicago, Ill., A. WEATHERWAX, M.A., Philadelphia, Pa.

GEO. F. THOMAS, M.D.

[1882-1924]

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

Editor: ARTHUR C. CHRISTIE, M.D.

Editorial Board: JAMES T. CASE, M.D. H. K. PANCOAST, M.D. WILLIAM DUANE, PH.D.

Advisory Board for Pathology: JAMES EWING, M.D. EUGENE OPIE, M.D. A. S. WARTHIN, M.D.

Collaborating Editors: The Officers and Committee Members of the Societies of which this JOURNAL is the official organ, whose names appear on the preceding page, are considered collaborating editors of this JOURNAL.

Foreign Collaborators: A. BECLERE, M.D., PARIS. GOSTA FORSSELL, M.D., STOCKHOLM. G. F. HAENISCH, M.D., HAMBURG. ROBERT KNOX, M.D., LONDON. R. LEDOUX-LEBARD, M.D., PARIS.

Publishers: PAUL B. HOEBER, INC., NEW YORK

Issued Monthly. Subscription $10.00 per year, $11.00 in Canada and $12.00 in foreign countries. Advertising rates submitted on application. Editorial office, 1909 Massachusetts Ave., N.W., Washington, D.C. Office of publication, 67-69 East 59th Street, New York.

Information of interest to all readers will be found on page vii. Lists of officers of The American Roentgen Ray Society and The American Radium Society will be found on page preceding Editorial Section.

THE STATUS OF RADIATION THERAPY IN LARYNGEAL CANCER

Radiation therapy in carcinoma of the larynx became well established with the advent of improved technique in the use of radium, mainly for three reasons; first, because the growth was located in an internal cavity apparently easy of access to direct radium application; second, external radiation by roentgen rays had been unsuccessful; and, third, operative procedures for the relief of the condition had proven difficult and unsuccessful. When the technique of direct radiation of laryngeal growths had reached its present stage of perfection, and for a time afterwards, the results were apparently very encouraging, except for the fact that in a number of instances over-radiation had produced most distressing symptoms. Unfortunately, subsequent experience has shown that recurrence is practically the invariable rule, even in comparatively early cases.

At a recent meeting of the American Radium Society it seemed to be practically the consensus of opinion that the treatment of laryngeal cancer by direct radium applications had proven to be an unsuccessful procedure and gave no promise of becoming otherwise in the future. Professor Regaud, of Paris, was the only one present who was able to throw any encouraging light upon an apparently hopeless situation from the standpoint of permanent cure, and the cases to which he referred were treated by external applications of deep penetration roentgen rays, according to a technique reported in a discussion in this issue of the Journal. There are many apparent reasons for the lack of success of direct radium treatment. Cancer of the larynx being of the squamous cell type, and highly resistant to radiation, requires that practically a caustic dose be applied to every portion of the growth to insure its complete eradication. Because of the anatomical peculiarities of the laryngeal structure such a dose as would be applied to a similar lesion elsewhere, as for example, to the uterine cervix, is prohibitive. Even a small part of such a dose would cause an intense perichondritis and destroy the cartilage, and thus break down the natural and most efficient barrier against the spread of the disease. As a result, rapid and extensive recurrence is favored, because our dose cannot be large enough to destroy every vestige of the growth. Superficial healing and apparent cure is a frequent experience with all of us, but there is possibly not the same tendency for successful cicatricial encapsulation as is found in many other portions of the body.

Applicators must be adjusted by indirect vision, under difficult conditions and often trying circumstances, and it is practically impossible to insure that the applicator will remain in adequate contact with every portion of the growth. Hence, unequal radiation is probably the rule, and especially just below the cords, from

which locality so many recurrences seem to take their origin. Growths in the anterior portion of the larynx remain localized for a comparatively long period of time because of the natural barrier offered by the cartilage and the lack of lymphatic drainage to favor metastasis. Even in this locality, however, direct radiation has proven unsuccessful. The necessity of preserving the cartilage precludes the employment of bare emanation tubes in the tissues surrounding the growth. In posterior growths, where lymphatic drainage is free, metastasis occurs at a comparatively early period, and most growths here are too extensive when seen to respond satisfactorily.

As direct radiation has apparently failed to cure laryngeal cancer, we, as a body of radio-therapists, should be the first to conscientiously announce this fact, and to state that our endeavors so far have been able to develop only a palliative measure, unless possibly some modification of radiation technique, such as has been suggested by Professor Regaud, may prove more efficacious on future trial.

If surgery could offer nothing more in the way of a cure than radiation has accomplished, possibly a continuation of careful radiation technique might still be regarded as the more satisfactory procedure. But fortunately, during the period of development of our methods, the technique of surgical procedure directed toward laryngeal cancer has made remarkable strides forward, and surgery has apparently much more to offer now than it had in former years. It is true that the necessary skill lies in the hands of but a comparatively few men at the present time, but there is no reason why many others should not become equally as skillful and successful.

In small anterior growths, laryngofissure and complete excision of the growth is the operation of choice, and in the more extensive lesions laryngectomy is indicated. Even in some rather extensive growths with cervical lymph gland metastasis the latter operation has been successful. There is apparently no harm in giving postoperative radiation, provided the dosage is kept within bounds short of injuring the cartilage. Whether or not it is in any way efficacious is a matter of doubt at present. In extensive posterior growths, preliminary tracheotomy followed by palliative radiation with moderate dosage seems to be the only procedure which can be followed.

H. K. Pancoast.

Subscribers to The American Journal of Roentgenology and Radium Therapy *visiting New York City, are invited to make the office of* The Journal (*69 East 59th Street, New York*) *their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

REPORT OF MEETING THE AMERICAN RADIUM SOCIETY

THE Ninth Annual Meeting of the American Radium Society was held at the Drake Hotel, Chicago. Ill., June 9 and 10, under the presidency of Dr. James T. Case of Battle Creek, Michigan.

At the Monday morning session the papers concerned the treatment of lesions of the head and neck.

Dr. William H. Schmidt emphasized the importance of a thorough knowledge of pathology in treating lesions of the head and neck, and the necessity of knowing the grade of malignancy in order to select the proper form of treatment and to conserve healthy tissue.

In their paper, Drs. New and Figi made the point that in fibrosis of the nasopharynx radium gives the best result, as it clears up the local expression of the disease and eliminates the mortality usually associated with surgical treatment. They emphasized the fact that true fibromas of the nasopharynx never metastasize.

In his paper on "The Treatment of Malignant Disease of the Mouth" Dr. Grier advanced the view that metastatic areas should receive as much attention as the primary lesion. He uses high voltage roentgen rays to the point of erythema on the metastatic region, and treats the primary lesion with surface applications of radium in Universal tube applicators. Buried needles are used only in cases in which parts of the lesion cannot be reached from the surface.

In discussion of this paper Dr. Regaud stressed the point that platinum needles containing small quantities of radium and allowed to remain in position for days were efficacious.

Dr. Pancoast, in his paper on "Some Observations on the Treatment of Carcinoma of the Larynx" advised surgery in this condition whenever possible, as he had not cured a single case by radium alone.

Dr. Simpson recommended radium for non-surgical removal of tonsils in cases where surgery is too great a risk. In hemophilics, and patients with tuberculosis and dangerous cardiovascular lesions, this method of removal of enlarged or infected tonsils may prove of value.

The Monday afternoon session was taken up with a consideration of radium in the treatment of carcinoma of the cervix uteri. Dr. Schreiner, Dr. Samuel, Dr. Leland, Jr., Dr. Levin and Dr. Schmitz presented the results obtained in their clinics from the use of radium or combined radium and roentgen radiation in the treatment of malignancies of the cervix and uterus. In the early operable and border-line cases the results were quite encouraging, but in the more advanced or inoperable cases very few survive for more than three years.

Dr. Howard Kelly in his discussion of these papers said that radium was better than surgery for these conditions, and in some of the extreme cases cures may be expected. Improved technique will undoubtedly increase the percentage of cures, but already it can be definitely stated that early cases of cervical carcinoma can be cured by the skilful application of radium and roentgen radiation, and in border-line and advanced cases much palliation results from using the combination.

Dr. Ewing stated that carcinoma of the cervix is a local disease. He was of the opinion that a hysterectomy following radiation treatment may stir up "slumbering cells."

Following this symposium, Dr. Young surveyed the results obtained from his use of radium in carcinoma of the prostate and bladder. Surgery alone often gives unsatisfactory results. He stressed the importance of conservative procedure, since an injury to the neck of bladder or

urethra may result in incontinence. He uses, for one hour periods, a 50 mg. universal tube and gold filtration in treating multiple areas in the bladder, urethra and rectum. He gives all treatments within six weeks and always alternates the portal. In treating bladder tumor, it is important to consider the type of tumor. If it is soft and fluffy, a combination of fulguration and radium is most satisfactory, and this is also true of the pedunculated tumor. When it is an infiltrating tumor, however, cautery should be only superficially used and radium should be implanted to destroy the base of the tumor.

Dr. Pomeroy and Dr. Milward discussed the use of radium in lesions of the female urethra. In cases of caruncle, a single treatment with a 50 mg. universal silver tube of radium, filtered through 1 mm. of brass and applied for from three to six hours, gives the best result. More radical treatment should be used if the condition is malignant.

At the annual banquet three addresses were given. Dr. Kelly spoke on the introduction and use of radium in this country, and its value in combating neoplastic disease.

Dr. Regaud of Paris told of his experimental work with radium and again recommended the use of small quantities of radium over long periods of time, and that the primary alpha and beta rays be filtered out to prevent destruction and resulting ulceration.

Dr. Ewing, in his talk, expressed the possibility of radium marking an epoch in the treatment of tumors. He mentioned not only the advantages, but also the disadvantages of radium as a therapeutic agent in cancer. Like Dr. Regaud, he objects to the method of using the buried bare tube, and said that the surgeon's knife was more kind to the patient than such a procedure.

At the Tuesday morning session, Dr. Failla spoke of the more purely physical aspects of radiation, and their relation to biology.

The paper of Drs. Clark, Morgan and Asnis was a timely one. Their objections to the caustic action of buried bare tubes were supported by case reports.

In treating cancer of the breast with radium, Dr. Lee reported that he had been able to save 17 per cent of his patients.

On Tuesday afternoon a clinic was held in the amphitheatre of Mercy Hospital, at which many interesting cases were presented. Dr. Beck showed patients demonstrating his most extensive resections, in which no sutures are used in the management of carcinoma of the jaw and cheek, supplemented by radium and roentgen therapy. Some patients were alive 3 and 5 years, and longer in a few instances.

Dr. Schmitz demonstrated a case of carcinoma of the breast treated from 1914 to 1920 inclusive.

Dr. Regaud spoke again at this meeting, presenting encouraging results of radium therapy in various types of cases.

Dr. Simpson read a paper on "Treatment of Cancer of the Tongue by the Implantation of Bare Glass Ampules containing Radium Emanation." Many cases were shown to prove the efficacy of this method in the treatment of carcinoma in this location.

A paper was read by Dr. Bundy on the "Value of Radium and X-ray in the Treatment of Benign Uterine Hemorrhage." His results were very satisfactory although one was impressed by the number of malignant tumors found at operation in the cases which failed to respond.

The papers presented at this meeting were of interest and the meeting as a whole was one of unusual value.

H. H. Bowing.

DEPARTMENT OF TECHNIQUE

Department Editor: DAVID R. BOWEN, M.D., Pennsylvania Hospital, Philadelphia, Pa.

In this department will be published from time to time, as material is available, suggestions for improvement in technique.

A PRACTICAL METHOD OF CONSTANTLY MEASURING THE RADIATION FROM A ROENTGEN TUBE WITH A CHECK AGAINST THE OMISSION OF FILTERS*

BY

J. L. WEATHERWAX, M.A. AND E. T. LEDDY, M.D.

Graduate School of Medicine, University of Pennsylvania and Philadelphia General Hospital

Philadelphia General Hospital

PHILADELPHIA, PENNSYLVANIA

THE roentgenologist, during the treatment of malignant diseases by roentgen radiation, is interested in knowing the quantity and quality of radiation striking the skin of the patient. The more we know of these two factors, the more nearly we will be able to reproduce a given amount of radiation reaching the desired area below the surface of the skin.

The penetration, which depends upon the quality of radiation, has been and still is being investigated by various workers. The present paper will not discuss this phase of the problem.

The knowledge of an accurate and constant radiation from a roentgen-ray tube is just as important as a knowledge of penetration of the roentgen rays. This problem has been solved to the satisfaction of various investigators. We have the Solomon iontoquantimeter, the Furstenau intensimeter, Duane's ionization system, and various other methods of determining the quantity of radiation emitted by a roentgen-ray tube.

None of the methods for measuring the quantity of roentgen radiation met all our requirements, which were as follows. (1) We wished to have a measurement of the intensity of the radiation at some fixed position so that with a given voltage on the target of the roentgen-ray tube, with a given milliamperage passing through the tube, and with a given filter, we could check our readings of the quantity of radiation continuously while treating a patient, and also from day to day; (2) we wished the apparatus measuring the quantity of radiation to be rugged so that the constant services of a physicist would not be required.

FIG. 1. Ionization chamber mounted underneath the tube holder.

Before building an apparatus to meet our requirements in measuring the intensity of roentgen radiation, we carefully investigated the various systems in use. Duane's[1] ionization system of making measurements met most of our require-

* Read at the Fifth Annual Meeting, Eastern Section, AMERICAN ROENTGEN RAY SOCIETY, Atlantic City, N. J., Jan. 24–26, 1924.

ments, except that the galvanometer used was too sensitive and not rugged enough.

We constructed a condenser type of ionization chamber and mounted this just below the copper filter, using the ionization chamber as a secondary filter, and connected the ionization chamber through batteries to a type P galvanometer. The galvanometer is mounted in the booth containing the control stand of the roentducting wires, one going through the galvanometer to, for instance, the positive pole of the batteries, and the other set of alternate plates going to ground, or to the negative pole of the batteries. This makes a complete circuit, except that the aluminum plates are separated by insulators. We can think of this circuit as we do of an electric lighting system with the circuit broken by any push button switch. The

FIG. 2. Galvanometer and scale mounted in the booth containing the control stand.

gen-ray machine, and the scale is visible to the operator at all times, making it possible to observe continuously the reading of the intensity of radiation after passing through the copper filter (Figs. 1, 2 and 3).

Figure 4 shows a diagrammatic illustration of the connections to the ionization chamber. It is seen that the ionization chamber is made of seven plates of aluminum, each aluminum plate 0.005 in. in thickness. Alternate plates of aluminum are connected to opposite insulated con- 110 volts are available, and as soon as the switch makes a complete circuit the current passes through the filament of the lamp bulb. You will notice in Figure 4 that the voltage is available, but the switch is open, because there is no connection between the aluminum plates. However, if we place the ionization chamber in the path of the roentgen rays, the switch will be closed and we will get a current through the galvanometer, which will be indicated by the movement of the spot of light on the scale in the operator's booth.

What causes the switch to close and a current to flow between the aluminum plates of the ionization chamber when the ionization chamber is placed in the path of roentgen rays? Duane[1] has explained why the ionization chamber and the galvanometer function, giving an indication of the intensity of roentgen rays. We will, however, review the reason for this.

The process upon which we depend to close the switch between the aluminum plates of the ionization chamber, as shown in Figure 4, is called ionization of the air between the plates. The air atom is composed of positive and negative electricity arranged in such a way as to neutralize each other in the undisturbed normal atom. We can think of the atom in terms of our planetary system, the sun corresponding to the nucleus of the atom which is composed of more positive than negative electricity; and the planets revolving around the sun representing in a crude way the negative electrons in their motion about the nucleus. These negative electrons are arranged in such positions, or paths, about the nucleus as to cause the normal atom to have as much positive as negative electricity. However, if a roentgen ray collides with an air atom, some of the negative electrons in the outer orbits will be dislodged from the atom, leaving the atom with more positive than negative electricity. Looking again at the ionization chamber (Fig. 4), it is seen that one set of plates is connected to the negative side of the battery. We know that like charges of electricity repel each other and that unlike charges of electricity attract each other, so that the positive part of the atom will be repelled from the plate connected to the positive pole of the batteries and attracted to the negative plate. In the same way the negative electron knocked from the atom will be attracted to the positive plate and repelled from the negative plate. It is necessary that the positively charged atom and the negative electron

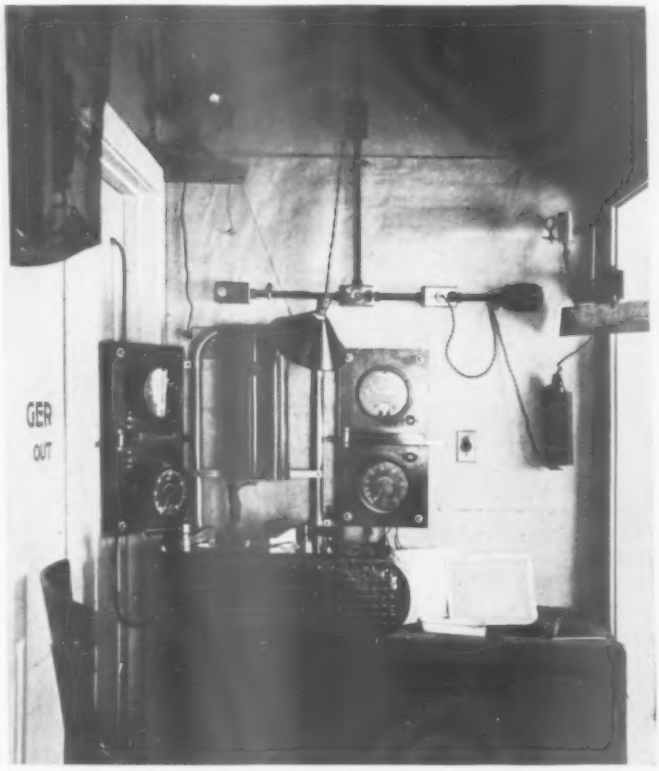


FIG. 3. View of scale from which the operator makes observations.

reach their respective charged plates before there is time for them to recombine and form a neutral atom. This means that the force of attraction between the positive plate and negative electron must be greater than the force of attraction between the positively charged atom and the negative electron. When the charge on the plates of the ionization chamber is large enough to sweep the positive and negative charges over to their respective plates as rapidly as they are produced by the roentgen rays colliding with the atom, then we have a saturated ionization current. The migration of the positively charged atom and the negative electron to their respective

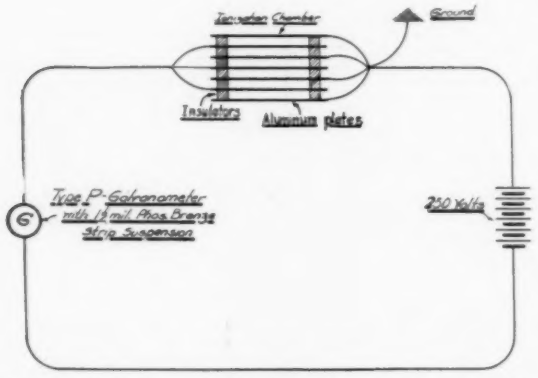


FIG. 4. A diagrammatic illustration of the connection to the ionization chamber.

charged plates is analogous to closing the switch to turn on the electric lights. These carriers of current from one plate to the other causes a current to flow through the galvanometer, which is indicated on the scale. The more intense the radiation, the greater the number of collisions with atoms and the more carriers of electricity between the plates of the ionization chamber, hence a greater current is registered by the galvanometer.

Curve (*A*) (Fig. 5) shows the saturation current of the galvanometer ionization chamber for intensity of roentgen radiation produced by 200,000 volts (peak) 4 ma., filtered through 0.5 mm. Cu. Curve (*B*) (Fig. 5) shows the saturation current produced by roentgen radiation, unfiltered except by $\frac{1}{16}$ in. hard rubber, which is a part of the ionization chamber. It requires less voltage to obtain a saturated ionization current produced by roentgen radiation filtered through 0.5 mm. of copper than unfiltered radiation. Batteries of about 350 volts are used in practice to insure a saturated current at all times.

The following table shows the galvanometer readings obtained when operating the roentgen-ray tube with 200,000 volts (peak), 4 ma. with various filters:

0.5 mm. Cu.....	40.5 arbitrary units
0.75 mm. Cu.....	30.0 arbitrary units
1.0 mm. Cu.....	24.5 arbitrary units

The galvanometer used is the ordinary Leeds and Northrup student type P with a sensitivity 0.014 to 0.001 microampere. These are built to withstand hard usage. The sensitivity of the galvanometer readings with copper filters is about equal to the sensitivity of the voltmeter and milliameter registering the voltage and milliamperage.

We have used two other galvanometers of fairly high sensitivity, but owing to vibrations and accidents, we were not able to have the operator check his readings, and hence he put no dependence in galvanometer readings as representing the roentgen radiation after it had passed through the filters. However, with the rugged galvanometer, readings are reproduced with a sufficient sensitivity. This apparatus has been in constant use for more than a year by the operator of our roentgen-ray machine.

We are able to operate the roentgen-ray tube accurately by observing the readings of the intensity of radiation, as observed on the galvanometer scale, and the milliampere, readings, since a small change in the voltage gives a corresponding change in the galvanometer reading. We have proven the accuracy of our readings by measurements with a horn ionization chamber on the surface of a phantom of water.

In addition to measuring the intensity of roentgen radiation continually, we are able to prevent the omission of a filter. Since the current passing between the plates of the ionization chamber depends upon the number of collisions with atoms, the greater the intensity of roentgen rays, the larger the number of collisions occurring per second, the carriers of cur-

rent are increased, hence a larger current passes through the galvanometer as is indicated on the scale. With a filter of 0.5 mm. of copper a reading of about 40 arbitrary units is obtained, and without a filter the reading is about 200 arbitrary units. This difference is at once recognized by the operator and he knows as soon as the roentgen radiation appears, which is about ten seconds after the roentgen rays have been turned on, that a filter has been omitted. The operator recognizes whether he is using the wrong filter due to variation in readings of the intensity of roentgen rays. An operator can therefore never use the wrong filter, nor omit a filter entirely, and an apparatus constantly indicating the output of roentgen radiation carries considerable weight in deciding whether the wrong filter, or no filter at all, was used.

The following examples show the possibilities of a measuring device in a fixed position in determining the intensity of roentgen radiation: If the number of milliampere-minutes has been previously determined for 200,000 volts (peak) and 0.5 mm. of copper, and the current is 4 ma., to produce an erythema, the scale of the galvanometer can be calibrated to give the number of minutes which will produce an erythema using a filter of 0.75 mm. and 1 mm. of copper, at, for instance, a given distance of 50 cm. from the target of the roentgen-ray tube to the skin. If the scale of the galvanometer is calibrated in equal arbitrary units, then, for example, the dosage can be obtained for a filter of 0.75 mm. Cu plus 1 mm. Al, knowing the erythema time for roentgen radiation filtered by 0.5 mm. Cu plus 1 mm. Al. Curve

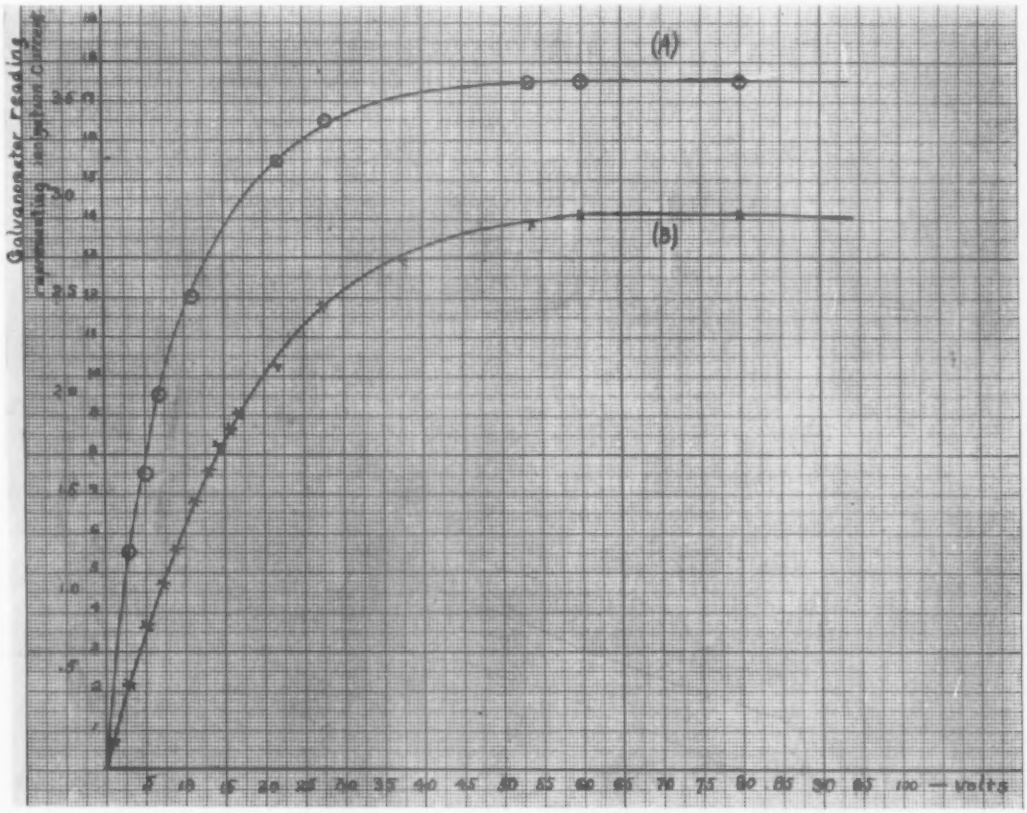


FIG. 5. Curve (*A*) shows the saturation current of the galvanometer ionization chamber for intensity of roentgen radiation produced by 200,000 volts (peak), 4 ma., filtered through 0.5 mm. Cu. Curve (*B*) shows the saturation current produced by roentgen radiation, unfiltered except by 1/16 in. hard rubber, which is a part of the ionization chamber.

(*F*) (Fig. 6) gives the relation of the intensity with various filters as measured directly underneath the target of the roentgen-ray tube with a small horn ionization chamber half submerged in water. If the reading of the roentgen-ray intensity filtered by 0.5 mm. Cu is 211 arbitrary units and the roentgen-ray intensity for 0.75 mm. Cu is 167 arbitrary units, the ratio of the two roentgen-ray intensities is $^{211}/_{167}$ or 1.264, as obtained from Curve (*F*). If 380 ma-min. are required to produce an erythema by roentgen radiation filtered by 0.75 mm. Cu plus 1 mm. Al, then 380 ma-min. times 1.264 gives 481 ma-min, which is the necessary radiation filtered by 0.75 mm. Cu plus 1 mm. Al to produce an erythema. However, if Curve (*D*) (Fig. 7) obtained by reading the intensity of roentgen radiation by the galvanometer ionization system, gives the value of the roentgen-ray intensity for various copper filters, the ratio of the intensities, as obtained from Curve (*D*) (Fig. 7) for 0.5 mm. Cu and 0.75 mm. Cu is $^{41}/_{30}$ which is equal to 1.37. If 380 ma-min. are multiplied by 1.37, we obtain 520 ma-min.

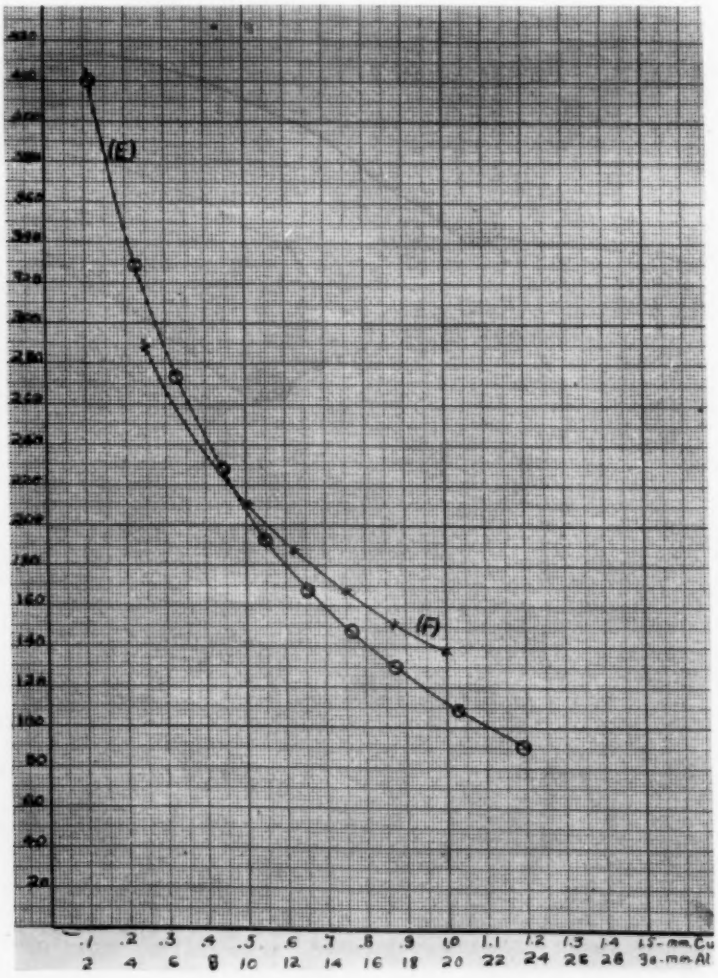


FIG. 6. Curve '(*E*) represents the intensity with various filters of aluminum as measured by a small horn ionization chamber on the surface of the water, half submerged 50 cm. from the target. Curve (*F*) gives the relation of the intensity with various filters as measured directly underneath the target of the roentgen-ray tube with a small horn ionization chamber half submerged in water.

We found a value of 481 ma-min. by the ratio of the intensities on the surface of the water, 50 cm. from the target, which represents the radiation falling on the skin; 520 ma-min. is seen to be too high for 0.75 mm. of copper filter. In order to use a galvanometer ionization system to compute the quantity of roentgen radiation necessary to produce an erythema, where the ionization chamber is in close proximity to the filter, a scale can be constructed by making the graduations such that when the ratio of the two radiation intensities for 0.5 mm. and 0.75 mm. Cu are obtained, the value will be 1.264 instead of 1.37. This will enable one to compute the quantity of roentgen radiation directly for a given filter and with a constant field of radiation.

Curve (*E*) (Fig. 6) represents the intensity with various filters of aluminum as measured by a small horn ionization chamber on the surface of the water, half submerged, 50 cm. from the target. Curve (*C*) (Fig. 7) represents the galvanometer reading of the intensity of roentgen radiation with various aluminum filters. Comparisons of the intensities for various thicknesses of aluminum filters can be made in the same manner as for copper.

In comparing Curve (*E*) with Curve (*F*) (Fig. 6) it is seen that one can obtain the various thicknesses of aluminum to give the same intensity as various thicknesses of copper, as measured by a horn ionization chamber on the surface of the water, 50 cm. from the target of the roentgen-ray tube.

In comparing the intensities of roentgen radiation filtered by copper and aluminum, it was found that to obtain the same intensity of radiation filtered by 1 mm. Cu, 16.2 mm. Al was required, as measured by a small horn ionization chamber, as seen from Curves (*E*) and (*F*) (Fig. 6). In order to obtain the same reading on the galvanometer scale registering the readings of roentgen-ray intensities from the large ionization chamber underneath the filter,

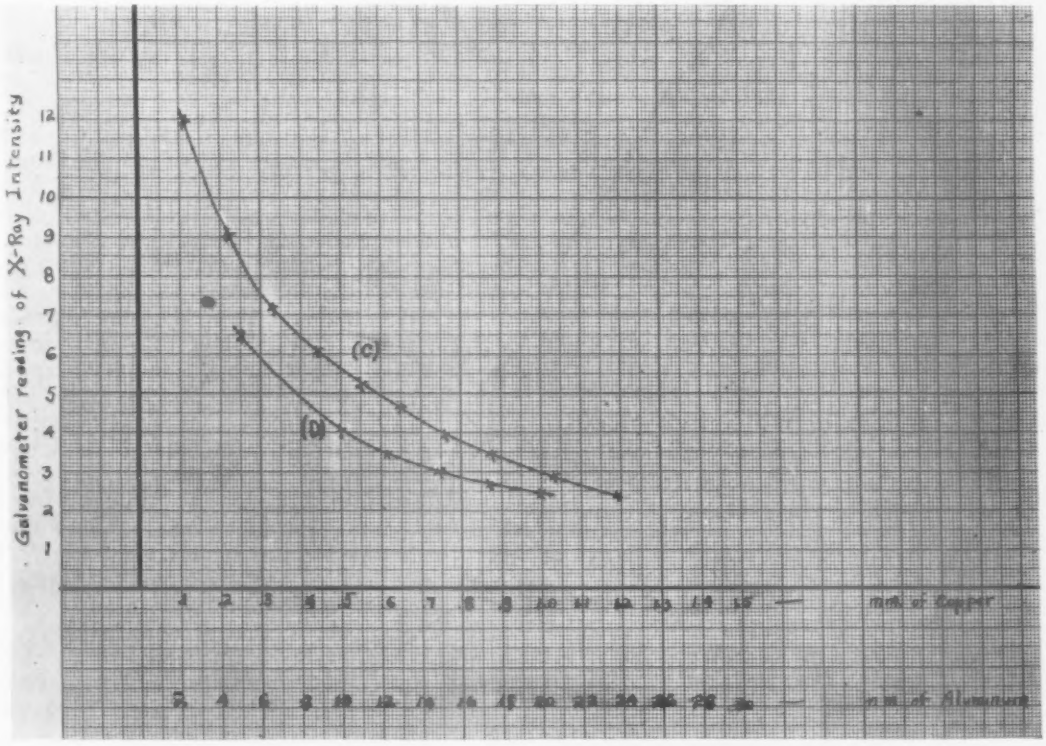


FIG. 7. Curve (*C*) represents the galvanometer reading of the intensity of roentgen radiation with various aluminum filters. Curve (*D*) gives the value of the roentgen ray intensity for various copper filters.

it required 23.5 mm. Al to absorb as much roentgen radiation as 1 mm. Cu, as seen from Curves (*D*) and (*C*) (Fig. 7). There is a difference of 7.4 mm. Al to give the same intensity measurements, as obtained by the two different ionization systems. However, this can be explained by the fact that aluminum being of much lower atomic weight than copper, the quantity of scattered radiation emerging from the aluminum is much greater than from copper. With the ionization chamber in close proximity to the filter, a greater quantity of the scattered roentgen rays reaches the ionization chamber than goes to the small ionization chamber which is a distance of 20 cm. from the filter.

CONCLUSIONS

It is seen that a simple device, rather inexpensive, can be constructed to measure continuously the roentgen radiation after passing through the filter, enabling one to observe the constancy of the radiation from a roentgen-ray tube.

The galvanometer ionization system gives the number of milliampere-minutes to produce an erythema with different filters after certain calibrations have been made. Examples of the method of making these calibrations are given. The satisfaction of having a constant, continuous reading of the quantity of roentgen radiation while treating is worth the trouble of calibration.

We have shown that it is impossible to omit a filter unknowingly, which we believe is valuable, since the human element is eliminated.

Failla and Quimby[2] have constructed an apparatus very similar to the one just described.

REFERENCES

1. Duane, W. The scientific basis of short wave-length therapy. Am. J. Roentgenol., 1922, ix, 781–791. Measurement of dosage by means of ionization chambers. Am. J. Roentgenol. (etc.), 1923, x, 399–405.
2. Failla, G., and Quimby, Edith D. The economics of dosimetry in radiotherapy. Am. J. Roentgenol. (etc.), 1923, x, 944–967.

DISCUSSION

Dr. G. Failla, New York City. Last year at this meeting I mentioned that I had been using an instrument similar to the one described by Mr. Weatherwax. I have had, therefore, some experieice with such a device. The object in view is to measure with sufficient precision the beam of radiation reaching the patient. In order to do this when different filters are used certain precautions must be taken. Friedrich's work has shown that with a very small ionization chamber made of organic materials, there is a parallelism between the ionization current and the doses necessary to produce a skin erythema, independent of the quality of the radiation within the ranges of wave-lengths usually employed in deep roentgenotherapy. Similar experiments made in our laboratory lead to the same conclusion. This, however, need not be necessarily true if a large ionization chamber is used. Accordingly we experimented with large chambers made of different materials to find out which agreed more closely with the small standard chamber. We found that one having plates made from a wide silk ribbon coated with India ink, fulfilled the requirements. An ionization chamber of the same size with thin aluminum plates gives readings which are not quite in agreement with the small chamber; on the other hand, the current is almost twice as large. When properly calibrated this can be used to advantage for practical purposes.

The next point to consider is the question of reliability when the instrument is used under conditions prevailing in the ordinary roentgen-ray installation. I have just returned from a trip to Europe where I visited a large number of roentgen-ray laboratories. I found that nearly every clinic has one (or more) roentgen-ray measuring devices but only in two or three places were they actually used regularly. In almost every case I inquired about these instruments and I was told in effect that they had been used for a time but, since doses could be duplicated satisfactorily by voltage and milliampere readings, their routine use had been abandoned. I asked also the following question: "Suppose that the measuring device indicates a certain time for the treatment which is considerably different from what you think it should be from past experience, would you give the treatment according to this reading?" Invariably the answer was: "No." This, of course, is the correct attitude to take even if the measuring instrument is very reliable. But taking everything into consideration, it is evident that the devices introduced until now are not satisfactory for the routine use in the roentgen-ray clinic.

In the case of iontoquantimeters we are confronted with the problem of measuring an extremely small electric current in a room where powerful electric disturbances are con-

stantly present. We need therefore a very sensitive electric instrument which must be carefully protected from external influences. The smaller the ionization chamber, the smaller will be the current and the more sensitive the instrument must be. In order to make an instrument which can be used for direct dosage, it is necessary to have a small ionization chamber. If a galvanometer is to be used to measure the current it must have the highest sensitivity obtainable at present. Now, if no galvanometer of greater sensitivity is made (in spite of the demand) it is because of the limitations imposed by extraneous causes.

In my experience the use of an instrument at the limit of its sensitivity is very undesirable in the roentgen-ray clinic. For this reason I think that Dr. Duane's measuring device is unsuited for dosage purposes. On the other hand, the size of the ionization chamber, which of necessity is quite large, precludes the accurate determination of depth doses in a water phantom. In view of these considerations, I am of the opinion that it is preferable to have a reliable instrument which gives sufficient information for dosage purposes than to have an unreliable one for direct dosage. The device described by Mr. Weatherwax makes use of a simple galvanometer well above the limit of sensitivity of such instruments and therefore is much more reliable than the galvanometer used by Dr. Duane. The information supplied by this device is sufficient for the calculation of skin doses. In regard to the determination of depth doses I believe it is a problem for the research laboratory and the roentgenologist will do much better to use averages of the data which have been published by different experimenters, approximating as closely as possible in his work the experimental conditions.

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

GLOCKER, R. Protection from rays in roentgen-ray work. *Naturwissenschaften*, 1924, xii, 169–173.

Danger from roentgen rays is due to 3 factors: intensity, penetrative power and excitation of secondary radiation. The principles involved, the physical properties of various materials as protective agents and practical means for their utilization are considered. Absorption increases with the atomic number of an element, and two substances of different thickness give the same protection if the product of the absorption coefficient and the thickness is the same. Experimental data show that the following relative thicknesses give the same protection: lead 1, rubber containing lead compounds 3.0, lead glass 8.5–9.7, barite 13.5. The intensity behind such materials is also a function of the size of the field. Thus, the intensity behind barite 6 cm. thick is twice as great when the radiation falls on 1000 sq. cm. as it is when it falls on 5 sq. cm. With radiation of the highest intensity, 0.38, 0.08, 0.03 and 0.01 per cent passed through lead 2, 3, 4 and 5 mm. thick, respectively.

GOLM. The harmlessness and importance of pyelography. *Med. Klinik*, March 23, 1924, xx, 379–381.

Kahlbaum's "umbrenal," a lithium iodide preparation was found to give sharp, "metal-like" contrasts and to be harmless in strictly selected non-ambulant cases. The best roentgenograms are obtained with the aid of the Bucky diaphragm. Pyelograms are presented showing, in the same individual, the relative shadow intensities produced by sodium bromide, sodium iodide and "umbrenal."

When carefully performed in cases selected after rigorous examination, pyelography is a harmless procedure and capable of yielding diagnostic information of importance.

JAKSCH-WARTENHORST, R. The roentgen diagnosis of pulmonary diseases. *Med. Klinik*, Jan. 6, 1924, xx, 5–6.

Typical extensive changes in the lungs were demonstrable roentgenologically in a young physician, yet other physical signs were absent, and there was no feeling of illness on the part of the patient. Promptly instituted therapy was however unavailing. In another case, the roentgen observation showed disseminated tuberculosis of both lungs, while the physical findings were very slight and limited to the right apex. The patient was in excellent condition. This was apparently a case of calcifying tuberculosis.

In the "first case of lung cysticercosis diagnosed *intra vitam*," the physical lung examination gave normal findings, and the symptoms were mild. Roentgen examination disclosed in each lung 6 circular, well-defined shadows somewhat larger than cherries, and irregularly located. There were also smaller and confluent spots in the right hilus. The roentgenogram of a cysticercus-infested pig's lung was very similar in appearance. This infestation of the human lung is a rare occurrence.

JÜNGLING, OTTO. Mammary carcinoma and its timely treatment by radiation and by surgery. *Klin. Wchnschr.*, June 10, 1924, iii, 1077.

A warning is raised against the recent suggestion of Jarre for conservative operation of mammary carcinoma in connection with prophylactic irradiation. It is known that radical operative treatment of this condition in the first stage results in 80 to 100 per cent permanent recoveries. This is supported by substantial statistical evidence; but there is little evidence favoring (and some evidence against) limited operation in conjunction with radiation therapy.

KELLER, HENRY. A clinical study of the mobility of the human spine. *Arch. Surg.*, March, 1924, viii, 627–657.

The size and thickness of the intervertebral disks are closely related to the amount and extent of mobility of the spine. If free mobility of the cervical and lumbar vertebrae is interfered with, these disks will diminish in size and thickness. Such diminution in size will result in loss of shock-absorbing power of the spine and thus affect the general nervous state.

Any operative procedure attempting to prevent or overcome rotation of the dorsal spine will fail unless the lumber spine is anchored at the same time, (owing to the latter's limited rotation), and both the dorsal and lumbar sections are made immobile by attaching the entire immobile column to the sacrum.

The free mobility of the lumbar spine is essential to the welfare of the human body and should not be interfered with except for weighty reasons. The extensive sympathetic nerve supply of the lumbar spine should be kept in mind especially in relation to the interpretation of symptoms often out of proportion to visible signs.

Injuries of the upper lumbar spine, although followed by ankylosis in that region, will have only a temporary crippling effect on the mobility of the entire lumbar region. As soon as healing and cessation of pain will permit, the lower portion of the spine will resume its normal position and compensate for loss of function of the upper part.

The muscles of the back should be studied as to their hyper- or hypo-excitability, temporary fatigue or permanent damage in relation to deformities of the spine.

Since most curvatures of the spine have their origin in the lower lumbar vertebrae at the junction of the sacro-lumbar, the roentgen-ray examination should include this region even though the physical examination does not warrant such inclusion. Roentgenograms through plaster corsets showing correction of curvature of the spine is obtained only when accompanied by longitudinal extension and counterextension. An apparatus for this purpose is described.

KLEIN, J. Study on the sedimentation velocity of erythrocytes before and after roentgen irradiation. *Strablentherapie*, 1924, xvi, 232–234.

Of 5 cases irradiated with 1 skin unit dose through heavy filter, 4 showed an increase in the sedimentation velocity. Forty-seven cases were irradiated with little or no filtration, and the majority showed an acceleration of sedimentation. In some instances, large skin areas were exposed, but more than half of these showed no change in the sedimentability of the red cells.

LEVIN, ISAAC. The biological action of the beta rays of radium. *Proc. Soc. Exper. Biol. & Med.*, May, 1924, xxi, 462–465.

Radium emanation in capillary glass tubes was used to study the effects of the beta and gamma rays which cannot easily be separated. The biological action of gamma rays alone and combined with beta rays is so different that certain conclusions may be drawn as to the action of the beta rays alone. The capillaries were inserted into normal and neoplastic tissues of animals and plants. The zone of tissue immediately surrounding the capillary was found in a state of complete necrosis. The second zone showed characteristic effects of gamma radiation, and was more extensive in tumor than in normal tissues.

Clinical results were significant. Pathological conditions resistant to large amounts of filtered radiation responded readily to beta radiation. Microscopically, human tissue examined 1 to 2 weeks after insertion of the capillaries showed the same conditions as described above for animal and plant tissues. In material studied 6 to 8 weeks after insertion of the capillaries, the necrotic tissue was mostly absorbed; and the second zone was replaced by connective tissue. The mechanism of the action of beta rays differs widely from the caustic effects of heat or chemical agents, and is qualitatively analogous to the action of gamma rays. The difference is merely quantitative, the ratio of beta to gamma rays from a unit of radium being about 100 to 1.

The statement that the biological effect of 1 millicurie of radium emanation buried in the tissues equals 132 millicurie-hours of surface application of filtered radium must be corrected since it does not take into account the action of the beta rays and their secondary rays.

MIESCHER, G. Roentgen erythema. *Strablentherapie*, 1924, xvi, 333–371.

The differing views as to the erythema dose suggested to the author an investigation conducted systematically on the question of skin reactions to roentgen rays. Experimental irradiations were applied to over 100 young girls, using a small field on the front of the thigh. The symmetry apparatus was used, 4 different qualities or radiation being applied with spark gap from 15 to 38 cm., unfiltered up to 0.5 mm. zinc. The dosage was controlled by means of an iontometer according to the Zeit technique. A scale of 7 degrees from trace of reddening to ulceration was constructed on a wax model and utilized for making comparisons. The graphic representation of the roentgen skin erythema was found to be a wave-like curve. The normal type consists of three erythemal waves. The first occurs between the first and fourth day, the second, between the eighth and twenty-second, and the third, between the thirty-fourth and fifty-first day. The third wave is the main one. Occasionally a fourth wave appeared on the sixtieth day. When the reactions were weak the waves did not make their appearance, and in intense reactions the separation of the waves was lost. The latency of the different waves is only slightly dependent upon the dose. The shortening of the latent period with increasing reaction, i.e., with increasing dose, is only apparent; the usually overlooked first and second waves then appear as the main reaction wave. It is also noteworthy that there appears to be no relationship between the reaction value and the character of radiation within wide ranges of radiation quality. Reaction form (reaction rhythm) or extent of reaction—is subject to relatively great individual variations. The variation of the extent of reaction for a given dose includes on

the average 3 degrees on the arbitrary erythemal scale.

Radiation was applied in 76 cases of different skin and hair coloration using strong doses, and in 56 similar cases using weak doses. A distinct influence of skin and hair coloration could not be demonstrated. Neither was there any hypersensitiveness that could be termed idiosyncrasy. Follicular swelling does indeed occur as a very frequent accompaniment of the stronger erythemas, but was absent in 14 per cent; and it appears to be a preliminary stage of diffuse erythema. The pigmentation curves are very similar to the erythema curves. Pigmentation waves may be absent, and in very strong reactions may be more complete than the corresponding erythema curves; and they may also appear independently. Comparison between the sensitiveness of the iontometer, the Sabouraud tablet and the skin showed general agreement for all the four radiation types *between iontometer and skin*. On the other hand, the Sabouraud tablet showed a very much higher sensitivity to the medium hard rays, and somewhat of a decrease in the zone of hardest radiation.

All the erythema waves are considered of an inflammatory nature. For the present, the question if various erythema waves represent a rhythm phenomenon, remains a matter for speculation. Among the practical results obtained in this work is the determination that the range of dosage within which skin erythemas occur is a very large one, comprising values which stand in the relation of 1:7; for instance, if the hardest radiation produced the slightest erythema in 10 minutes, it would give rise to erythema with blister in 70 minutes. It is not safe to use as a unit of measure the erythema with blister formation, because the latter may develop into an ulcer.

KNIPPING, H. W., and KOWITZ, H. L. The effect of roentgen rays on proteins of the plasma. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, March, 1924, xxxi, 660–664.

The fibrinogen, euglobulin, pseudoglobulin and albumin fractions were determined simultaneously in the plasma of patients before and after irradiation. Studies were also made of protein sols and of plasma irradiated *in vitro*. The radiation was produced by a symmetry apparatus through heavy filter of Al for periods varying from 6 to 150 minutes.

After irradiation of patients, there was definite increase in fibrinogen, euglobulin and pseudoglobulin, and decrease in albumin. The *in vitro* experiments, even with very high doses gave slighter and contradictory changes in the direction of greater stabilization. The products of cell breakdown after irradiation of the organism cause the plasma changes. This indirect effect is very strong; and beneath it is hidden the slight direct effect observed after irradiation of the proteins *in vitro*.

KROLL, FRITZ. Roentgen treatment of chilblain. *Med. Klinik*, April 13, 1924, xx, 485–486.

The advantage in roentgen-ray treatment lies in the simplicity of application as compared with inunction, and the greater comfort to the patient. The dosage is from ½ to ⅓ skin unit dose filtered through 0.5 to 3.0 mm. Al, repeated every 4 weeks when necessary. The results in 17 cases are summarized as temporarily favorable, in general; but a longer observation has shown none of the patients completely cured. Roentgen therapy produces at least marked relief in a large percentage of the cases.

SCHOTT, ADOLF. The diagnosis of high grade dilatation of the left auricle. *Klin. Wchnschr.*, June 10, 1924, iii, 1067–1069.

The spreading of the acutely dilated left auricle back of and beyond the right auricle into the right lung hilus is typical in mitral stenosis, but until recently, this fact remained unrecognized clinically and roentgenologically. A description is given of 6 cases with and without other complications of the circulatory system. In all these cases, it was concluded that the left auricle formed a portion of the right boundary of the heart shadow. Autopsy in 2 cases confirmed this conclusion, and the gradual change of the heart contour in the others extending over a period of several years made this diagnosis highly probable. The striking configuration of the right heart boundary when viewed roentgenoscopically is shown in a series of sketches.

APFEL, HARRY. Hypertrophic pyloric stenosis in an infant. *Med. J. & Rec., N. Y.*, July 2, 1924, cxx, 17–19.

The infant, 11 weeks old, was suffering from persistent vomiting and loss of weight. Roentgenoscopic examination showed the stomach three-fourths full after 3 hours with but little food through the pylorus. At the end of 6 hours there was still a residue of one-third of the meal in the stomach. The stomach presented an hour-glass appearance. The diagnosis of hypertrophic stenosis of the pylorus was corroborated. A hard cartilaginous tumor of the pylorus was successfully removed.

ARNELL, SIGFRID. An apparatus for making sketches of radiograms. *Acta radiol., Stockholm*, 1924, iii, 176–179.

Sketches of roentgenograms are of use frequently in case history reports and for

illustrating statements to be sent to other physicians. An aid for the making of such sketches is the device described by the author. This consists of a box with mirrors so arranged as to reflect the image from the roentgen plate through an ocular and camera lucida such as is used in making drawings of objects observed in the microscope.

ANDERSON, C. C. Regeneration of bone after intensive radiation of malignant disease. *Brit. J. Radiol.*, February, 1924, xxix, 37–43.

Three cases are presented showing that regeneration can occur in bone which has been apparently completely destroyed by neoplastic invasion. The continuity of the bone at the seat of fracture caused by malignant disease, especially sarcoma, was restored in 2 cases by intensive radiation. One of the cases had a tumor, endosteal in origin, which was of the slow-growing type and gradually expanded the bone to produce permanent alteration in contour. The expectation of life in osteosarcoma is necessarily limited.

BAASTRUP, CHR. I. A case of diverticulum of the jejunum diagnosed by means of radiography. *Acta radiol., Stockholm*, 1924, iii, 164–166.

This rare condition was observed in a woman 43 years old. The objective examination revealed nothing abnormal except a slight tenderness below the right curvature. Roentgen examination following a barium meal disclosed a small, roundish shadow distinct from the stomach shadow. The appearance and shape of the shadow led to the diagnosis of diverticulum of the small intestine. Operation confirmed the diagnosis and showed the diverticulum to be due to traction caused by adhesions. The adhesions were detached and the symptoms of the patient were removed.

BAASTRUP, CHR. I. Roentgenological studies of the inner surface of the stomach and of the movements of the gastric contents. *Acta radiol., Stockholm*, 1924, iii, 180–204.

Two new methods for rendering the inner surface of the stomach visible roentgenographically are described. The first consists in covering the walls with dry bismuth powder while the cavity of the stomach is filled with air. This method has not been fully worked out, because it is rather troublesome and does not give the best results. By its use a picture of the stomach was obtained showing a cicatrix in the region of the greater curvature, a rather rare occurrence. The second method consists in covering the stomach walls with a coat of barium meal while the rest of the cavity is filled with a substance that does not produce shadow (for instance, a tablespoonful of concentrated barium meal followed by 200 to 300 grams of rice flour paste).

A series of physiological studies was undertaken with use of the second method. A "sulcus salivalis" in the sense of a furrow or canal through which water may pass other gastric contents, does not exist in man in the erect posture, at any rate, not when the gastric contents have different specific gravities. The folds of the mucous membrane in man in the erect posture will often have a longitudinal direction up to the greater curvature. Frequently, a transverse fold or pouch in the fundus is observed very distinctly in pictures of the inner surface of the stomach. It seems hardly due to pressure from the colon. The movements of the food after its entrance into the stomach, as observed by the aid of this method, are in many points different from those conceived in current views on the subject. The specific gravity of the food stuffs must be considered a factor of great significance for their relative distribution in the stomach, a fact which does not seem to have been emphasized sufficiently in the past.

This method has also been of value in detecting pathological conditions in the stomach as illustrated by a case of gastric ulcer and one of gastric cancer.

CROWTHER, J. A. Studies in x-ray production. *Brit. J. Radiol.* (*Röntgen Soc. Section*), April, 1924, xx, 61–72.

Simultaneous photographic records are given of the values of potential, tube current, intensity and quality of radiation emitted at each point of the discharge by Coolidge and gas-filled tubes with different potential generators. Oscillograms are shown illustrating results from various combinations of apparatus.

It is found that the intensity of the radiation is proportional at each point to the product of the instantaneous values of the current and the square of the potential. The Coolidge tube behaves as a thermionic valve, working usually far beyond its saturation voltage, being thus virtually a constant maximum current device. In the Coolidge tube on an induction coil, the lack of proportionality between current and output is due to change in wave-form of the secondary potential of the coil with decreasing resistance in the tube.

The peak current through a gas tube is proportional to $V^2-V^2_0$, where V is the peak potential, and V_0 the breakdown voltage of the tube. On open circuit, the peak voltage in the secondary is proportional to the instantaneous value of the primary current at break. If the secondary is connected through a gas-filled

tube, the peak voltage is approximately proportional to the current at break. The discharge through a gas-filled tube on a transformer is oscillatory, the period being about 2000 per second. The break-down voltage for the tube increases during discharge, but returns to normal during each succeeding interval of rest.

BENTZON, P. G. K. Roentgenological and experimental studies on the pathogenesis of the dyschondroplasia (Ollier's disease). *Acta radiol., Stockholm*, 1924, iii, 89–112.

After study of a case in a girl 15 years old and of experimental observations on rabbits, the author concludes that dyschondroplasia (Ollier's disease) is a neurotrophic disorder of the bony tissue caused by anomalies in the innervation of the vessels in the bones. This is contrary to the opinion of Ollier and Wittek who believe it to be a disturbance of the epiphyseal growth. Clinical studies, aided by examination of numerous roentgenograms, disclose the following features of the disease. It is often confined to one-half the body; the masses of hyaline cartilage are found to follow paths similar to those of the arteries of the bones; interruption of the nerves to the vessels (in rabbits) has in some cases been successful in producing changes in the bony tissue which resemble the structural changes seen in Ollier's disease; the pathological processes in the bony tissue may be regarded as in some way related to the phenomena observed in callus formation.

DESSECKER, C. Epiphrenal diverticulum of the mucosa of the esophagus. *Arch. f. klin. Chir.*, 1924, cxxviii, 236–247.

This condition is suggested as originating in the following manner: A mucosal hernia develops proximal to the spastically contracted sphincter at a site weakened by congenital defect. Stasis and the negative pressure in the interior of the thorax caused this hernia to grow larger. In the course of years the clinical symptoms (difficulty in swallowing) gradually develop to the picture of emaciation.

In the case described, the roentgen-ray examination showed the first mouthful empty smoothly into the stomach. There then appeared at the right of the esophagus, a little above the cardia a smooth, plate-like extension of the shadow which finally developed into a spherical area filled half with air and half with food. This space could not be more than half filled with food, and beyond this the food again entered the stomach. Examination disclosed this to be a circumscribed dilatation at the back of the esophagus. Complete emptying occurred in the left lateral position. Later roentgen examination suddenly disclosed this diverticulum at the left of the esophagus.

DANIELSSON, E., and MANFRED, J. Some experiences of bronchography after injections of lipiodol. *Acta radiol., Stockholm*, 1924, iii, 157–160.

A report is given of the roentgenoscopic appearance of the bronchi after the injection of a preparation known as lipiodol. This preparation has the consistence of glycerine, contains 40 per cent, by weight, of iodine dissolved in oil of cloves. With the aid of the laryngoscope, the syringe injects about 3 cc. of the oil into the larynx after cocainization of the epiglottis. The injection is repeated until about 15 cc. of the oil has been administered; and roentgenoscopic examination is made at once. By inclining the patient in different positions the bronchi in the various lobes are coated with the material and give beautiful pictures of their form and ramifications. The communications between cavities and the bronchi can be seen all the way to the attachment of lateral adhesions. The therapeutic effect of lipiodol remains a subject for further discussion.

DORLAND, W. A. NEWMAN. Obstetric roentgenography. *Radiology*, July, 1924, iii, 10–19.

Observations of the effects of roentgen rays on germinal cells in species other than the human have shown profound changes which are at first stimulating and subsequently depressing in character. Such observations in the human being are still lacking, but the statements of Bailey and Bagg suggest, in addition to the pronounced effect during early pregnancy, that there is a possibility of producing gross abnormalities at birth by irradiation in late pregnancy which may hinder growth and development in later life.

After the seventh week of intra-uterine life, the various centers of ossification in the fetus begin to appear vaguely in the roentgenogram. From that time on the development, position and movements of the fetus may be more or less closely followed. From the obstetrical viewpoint the roentgenoscopic appearances of variously shaped pelves are of importance in determining procedure. This method may also serve to differentiate between a tumor and pregnancy in doubtful conditions.

It is hoped that as time advances a valuable collection of plates may be accumulated for future use in pelvimetry. The utility of the roentgen picture in diagnosing normal and abnormal pregnancy is obvious. Advanced ectopic pregnancy is quite capable of diagnosis by this method and even in the early stage, ectopic gestation may be diagnosed under

favorable conditions by the roentgen rays. Of scientific interest is the use of the roentgen ray in teratology. This will obviate the cutting up of various types of fetal monsters for purposes of tracing the bony development.

GIBSON, J. D. Radiotherapy technic. *Med. J. & Rec., N. Y.*, May 21, 1924, cxix, 490–492.

Some of the details of determination of dosage in radiation therapy are touched upon. In treatment of tuberculosis by the stimulating effects of roentgen radiation, the author uses 2 ma., 8-in. spark-gap for 10 min. at a distance of 12 in., in the case of thin persons; for heavier patients the current is increased to 3 ma. One of these doses is given three times weekly, alternating from back to front of the chest, through 2 mm. Al followed on alternate days with a one pole static stress application. Inhibitive treatment as given in cases of alopecia, ringworm and favus comprises one erythema unit given by 3 ma., 9-in. spark-gap, 8-in. skin focal distance.

EDEIKEN, LOUIS. The x-ray as an aid in the differential diagnosis of abdominal and chest conditions. *Med. J. & Rec., N. Y.*, May 21, 1924, cxix, 492–493.

A number of conditions are enumerated in which the roentgenologist can furnish deciding evidence in differentiation. Pneumonia and acute appendicitis, especially in children, are frequently difficult to differentiate because of confusing physical signs. The roentgenogram will very readily reveal the existence of early pneumonia, and may obviate unnecessary surgical intervention.

Roentgenoscopic examination will frequently distinguish between empyema and subphrenic abscess, although the physical signs in both conditions are similar. In subphrenic abscess the diaphragm is greatly elevated and its respiratory excursions are restricted. The costophrenic angle is clear. In empyema the diaphragm is not seen, the costophrenic angle is obliterated and a fluid level is observed.

Pleurisy often simulates cholecystitis in certain symptoms but the roentgenogram is able to differentiate between them. In pleurisy roentgenoscopic examination may reveal pleural adhesions and limitation of the excursion of the diaphragm. In gall-bladder conditions the picture of this organ will frequently indicate the diagnosis.

Roentgenographic examination is distinctly valuable in differentiating traumatic pneumo- or hemopneumothorax from intra-abdominal perforation and hemorrhage of traumatic origin. Cardiac and aortic lesions are quite different from suspected lesions of the stomach and duodenum when seen in the roentgenogram. Lower esophageal conditions and gastric lesions both cause epigastric discomfort. Cardiospasm and organic stricture can be differentiated from gastric lesions by the roentgenoscopic evidence. Benign cicatricial strictures give the same picture as malignant lesions and must be differentiated by history and other data.

Tumors of the liver and spleen may be differentiated from masses in the lower lobes of the lungs by judicial use of pneumoperitoneum. This latter procedure is, however, not recommended as a routine.

GÖCKE, C. Joint formation in the transverse processes of the first lumbar vertebra. *Arch. f. klin. Chir.*, 1924, cxxviii, 334–341.

In 180 vertebrae examined roentgenologically 4 cases showed definitely joint formation at the first lumbar vertebra, 2 of them bilateral. Origin through trauma or by delayed development through retention of an epiphysis of the lateral process, and likewise rudimentary lumbar ribs seem to be excluded. Development of a costal element is assumed which normally is fused with the lateral process. This delayed development occurs most usually in vertebrae with numerical variation, and is important particularly in industrial accidents involving the spine since they may be confused with fractures of the lateral process.

KÖNIG, ERNST, and RAUCH, HANS. The histology and etiology of Köhler's metatarsal disease. *Arch. f. klin. Chir.*, 1924, cxxviii, 369–381.

Conservative treatment of a case of Köhler's disease yielded no results, but resection of the head of the second metatarsus produced relief. Microscopic examination disclosed the following: Partial replacement of the spongiosa and marrow in the epiphysis by connective tissue rich in blood vessels, new bone formation, and two small necrotic foci; endarteritis obliterans was present in the metaphyseal periosteum. The primary process is disease of the periosteal vessels which produces regressive and destructive changes in the epiphysis by disturbance in nutrition. Disturbances of the endocrine glands are supposed to be responsible for the condition in Köhler's and related diseases.

HOLFELDER, H., BORNHAUSER, O., and YALOUSSIS, E. The intensity distribution of roentgen rays within the body. I. *Strahlentherapie*, 1924, xvi, 412–446.

An attempt is made to explain the underlying principles of the distribution of radiation. First, an experiment was made to determine what influence skin-focus distance and the size,

form and position of the screen exert on the intensity distribution in the water phantom. A Siemens roentgen dose-meter, measuring the saturation current flowing through an ionization chamber, was used for the determinations. Errors due to size of the measuring chamber and its holder were corrected for by control measurements. The measuring chamber screens off the transition from radiation to shadow at the periphery of the sphere of radiation. The magnitude of this screening effect was determined by drawing a lead diaphragm millimeter by millimeter over the chamber. The diffuse shadow cast by the measuring chamber holder makes the determination of the percentage deep dose about 1 to 2 per cent too low. Measurements in the region outside the sphere of radiation, with the chamber parallel to the axial ray gave higher values than with the chamber placed cross-wise; that is, the scattered radiation mantle was greater in the first position. The measurements thus obtained were corrected for the screening effect of the measuring chamber and the diffuse shadow of the holder. Iso-dose curves, corrected intensity curves and transformed iso-dose curves are given for several cases.

It appears that, contrary to Dessauer's results, the sphere of radiation is sharply defined even at great depths. Scattered radiation therefore does not produce an appreciable effect on the configuration of the iso-dose curves. Only a narrow zone of scattered radiation of rather slight energy value surrounds the primary radiation sphere. For purposes of deep therapy, this mantle of scattered radiation certainly has no practical significance. Variations produced by the shapes of the screens upon the base boundary of the radiation pyramids are slight and may be neglected in practice. The square form of screen usually gives assurance that the radiation pyramids remain sharp-cornered even in the depth, and appears to be the most appropriate form of screen for deep therapy. The boundary between roentgen ray and shadow shifts somewhat into the penumbral zone when the screen is placed at a distance from the skin surface; but the mantle of scattered radiation is not intensified thereby. Experience recommends placing the screen on the patient's skin because of the somewhat greater depth action. If, however, a gradual transfer to the side is intended, then screening at a distance from the skin is recommended; but in that event, the distance between skin and screen must be 3 times as great as that between screen and tube focus.

Observations on a fluorescent screen immersed in the water phantom and on a film exposed (by Gottlieb's method) from within the water phantom confirm the results and reveal the narrow pear-shaped mantle of scattered radiation. The intensity curve of the central ray remains flat for the first 3 cm. and then begins to drop off. At a depth of 12 to 14 cm. the curve flattens out again. The percentage deep dose, determined by the relation of deep dose at 10 cm. to that at the surface, therefore characterizes satisfactorily the depth effect of a radiation sphere. Since the smallest drop in intensity occurs close to the surface, methods demanding that superficial tumors be covered are disadvantageous. Building up with covering layers is indicated only in locations where it is necessary to smooth out irregularities of the body surface.

McArthur, Lewis L. Therapeutic radiation from the surgeon's standpoint. *Radiology*, July, 1924, iii, 7–9.

It is pointed out that the surgeon has come to lean more and more heavily on the roentgenologist in matters of treatment; and this may not have been to the best interests of the patient at all times. The advent of high voltage apparatus has made readily available doses of enormous intensity. This has led to use of larger dosage with resulting greater injury in the effort to approximate the so-called cancer lethal dose. Until more is known of the precise effects of heavy dosage it seems wise to continue the use of smaller, divided doses which have shown themselves in many cases to be highly efficacious. Instances are cited to show lack of coordination between the roentgenologist and the internist or the personal physician of the patient. Very frequently the physician from close contact and knowledge of his case is aware of obvious contraindications which might be avoided by practice of cooperative spirit on the part of the roentgenologist.

Moore, H. On the quality of the x-rays excited in hot cathode and in "gas" tubes by various types of generators of high-tension current. *Brit. J. Radiol.* (*Röntgen Soc. Section*), April, 1924, xx, 73–99.

Roentgen radiation excited in different forms of tube operated by different forms of high tension generating apparatus was investigated by observation methods and by spectrum analysis of the radiation, using an ionization spectrum. The generating apparatus used were: (1) an induction coil; (2) a Snook apparatus, and (3) high-tension D. C. generators. Minimum heterogeneity of radiation was produced by the following combinations in the order given: (*a*) either type of tube with constant voltage generator; (*b*) gas tube working at large alternative spark-gap either on Snook appara-

tus or induction coil; (*c*) gas tube working at medium alternative spark-gap on a Snook apparatus or induction coil; (*d*) Coolidge tube operated by Snook apparatus; and (*e*) Coolidge tube operated by an induction coil, particularly with large currents passing through the tube.

Comparisons of the spectra show that the quality of roentgen radiation obtained from a tube operated by an induction coil or by a transformer can be estimated only approximately by measurement of the alternative spark-gap. The spectra indicate that a Coolidge tube is less efficient than a gas tube when operated by a Snook apparatus or by an induction coil. These tubes are equally efficient when operated by a constant voltage generator.

A constant voltage generator possesses the following advantages for the common tubes in use: The radiation obtained is as nearly homogeneous as possible; the quality depends solely on the voltage applied; it yields the greatest efficiency of generation of roentgen radiation; quantity of radiation excited can be measured for any particular voltage in terms of ma-sec.; the quality of the radiation beam can be determined at once from the voltage applied or can be altered in a known manner; its use would enable accurate dosage measurements to be made, and would enable a particular dose to be repeated precisely.

LEONTJEWA, L. A. Changes in the bones and joints in sclerodermia. *Arcb. f. klin. Cbir.*, 1924, cxxviii, 293–301.

The case described is of especial interest because of the extent of the involved areas and because the changes in the bones exceeded those of the skin. There was symmetrical involvement of the bones on the right and left hands without dermal involvement in those areas. Roentgenologically, there was found atrophy of the bones, decrease or disappearance of the joint spaces, broadening of the joint cross-section and dilatation of the sella turcica.

MORRISEY, JOHN H., and SMITH, FREDERICK W. Symptomatology and diagnosis of polycystic kidney. *Med. J. & Rec., N. Y.*, May 21, 1924, cxix, 494–497.

Since the introduction of pyelography, cases of double ureter, bifid pelvis and similar conditions are becoming recognized with greater frequency. It seems probable that polycystic disease of the kidney also may come under observation more frequently. This condition is due apparently to the same causes that are responsible for other malformations of the urinary system.

Heredity plays an important part in this malformation, and this factor should be kept in mind once the diagnosis has been established. From a prophylactic view point it should be of value in suggesting the proper care of other members of the patient's family. Simple operative methods such as puncture of the cyst have a palliative value. Nephrectomy is indicated only when function has disappeared. Three cases are described.

NICHOLS, B. H. Special points in roentgenology of the urinary tract. *Radiology*, July, 1924, iii, 1–6.

The observations are based on 110 complete examinations of the kidneys, ureters and bladder. Diagnosis based on the films alone would have been confirmed at operation in 85 per cent of the cases. Additional study by means of pyelograms, etc., permitted diagnosis which was confirmed in every case. The cases include calculi, tuberculosis, hydronephrosis, pyonephrosis, tumor, and stricture of the ureter.

The roentgen examination should include the entire urinary tract; and necessitates thorough familiarity with the diseases of the genito-urinary tract. Lateral films should always be included when taking cystograms. Films should be made in two positions with catheters in place to aid in identifying suspicious shadows. A catheter study of the ureters should be followed by ureterograms when the suspicious shadow is not in contact with the catheter. The ureter should be studied while the catheter is withdrawn to demonstrate kinked or tortuous ureters. All examinations should be made immediately after injection of the kidney pelvis.

Differential diagnosis between kidney stones and gall stones can be made frequently by plates of the abdomen, the shadows of gall stones being smaller, more distinct and closer to the spine. A differential diagnosis between kidney lesions and diseases of the sacroiliac region can be made by including on the initial plates a stereoscopic study of the lumbar spine and the sacroiliac region. All cases of calculus should be re-roentgenoscoped just before operation, in order to rule out enteroliths and to confirm the position of the stones.

PANNER, H. J. Separations from the capitulum humeri as the most frequent determining cause of arthritis deformans cubiti. *Acta radiol., Stockholm*, 1924, iii, 129–156.

The very common arthritis deformans cubiti is most frequently due to so-called "osteochondritis dissecans" of the capitulum humeri. The disease begins probably always between the ages of 12 and 20. It is of traumatic origin, and is most frequent in male apprentices of the artisan and agricultural classes. It occurs

more rarely in females. If an individual predisposition exists, its nature is entirely unknown. The trauma produces a subchondral lesion and often a fissure in the cartilage of the capitulum humeri, the fissure often extending into the bone somewhat. The early symptoms are very slight as a rule, consisting merely in reduced power of motion, particularly as regards extension. In the later stages all the symptoms of arthritis deformans may appear, though the slightness of the symptoms and the severity of the anatomical changes are frequently striking. The roentgen picture is typical in all the stages; at first, there are only large or small rarefactions in the capitulum humeri. Later, there are seen shadows of corpora libera and deformities which are most pronounced in the head of the radius. The pronounced contrast in the roentgen picture produced by these lesions of the cartilage is probably explained by the occurrence of secondary changes in the immediate neighborhood of the original lesion, involving necrosis and absorption of osseous tissue. The disease may therefore be regarded entirely as a traumatic lesion rather than an inflammatory condition. The roentgen examination is quickly able to distinguish this condition from tuberculosis. Prognosis depends on intervention of the proper treatment at the right time. Treatment consists in removal of the corpus liberum and scraping and smoothing down of the site of the lesion in the capitulum humeri. If well-developed arthritis deformans already exists, the prognosis is doubtful, and operative removal is at best only a palliative.

RAHM, H. The problem of homogeneous irradiation of diseased tissue. *Strahlentherapie*, 1924, xvi, 451–474.

The requirement that diseased tissue be homogeneously traversed by roentgen rays still remains to be accomplished. Not until then can the biological problems of radiation therapy be tested unequivocally. The author attempts the attainment of homogeneous irradiation by use of converging roentgen rays through *one* application area. Unfiltered radiation falls from a focal distance of 30 cm. upon a paraffin block of 20 cm. diameter. On the other side of the paraffin block is placed a convergence screen (analogous to the Bucky honeycomb screen). Of the rays emerging from the paraffin block, practically only the converging ones go through the screen. This of course causes a great loss in energy, since only $\frac{1}{10}$ of the radiation leaves the screen. After passage through the screen, however, the radiation density increases. If the radiation intensity at the screen is called 100 per cent, it becomes in air 5 cm. away from the screen, 109 per cent and at 10 cm., 117 per cent. In water, the value 5 cm. from the screen is 87.5 per cent. Other experimental conditions are able to produce still higher depth values. For more advantageous utilization of intensity a two-tube system is utilized. To eliminate non-uniformity of body surface, as for instance in the irradiation of carcinoma of the tongue, the introduction of a paraffin negative is recommended. In this manner a paraffin block is irradiated, representing a standard substance having almost uniform homogeneous depth distribution with known values. Since paraffin is too expensive under present German conditions, two hot water bottles may be taken as standards. Their walls are elastic enough to fit into the irregularities of the head parts, a rubber tube being used for breathing. For the purpose of homogeneous irradiation of extremities, the limb is placed in a water bath. The radiation intensities in the water bath are determined once for all.

RAPPE, ADOLF. A case of roentgenologically diagnosed osteoma of the superior maxilla. *Acta radiol., Stockholm*, 1924, iii, 161–163.

The case described is interesting in that diagnosis of osteoma was based upon the detection of the structure of the tumor on a roentgenogram taken with an intra-oral film. The structure of the spongious bone was quite distinct. Operation confirmed the diagnosis. So far as the literature shows, this is the first case so diagnosed.

SCHOLZ, THOMAS. The diagnosis of spinal metastases having a clinically latent primary focus within the chest. *Med. J. & Rec., N. Y.*, July 16, 1924, cxx, xx–xxix.

This is a report of 4 cases of spinal metastases, the primary focus in each instance being located in the thorax. The primary focus failed to give rise to any clinical symptoms for a long time; but they could have been demonstrated roentgenologically at an early time and with ease. Examination of the chest, however, was not made because attention was directed to the more prominent symptoms produced by the spinal condition. In the first case the primary tumor was in the right upper lobe of the lung with metastases in the sacrum, the skull and the lower two lumbar vertebrae. The second was that of a primary mediastinal tumor with metastatic focus in the thoracic spine and in the occipital region. Case III had a primary tumor in the left lung with metastases in the three upper lumbar vertebrae, some of the ribs, the skull and the right pleura. The primary tumor in the fourth case was an endothelioma of the right lung with metastases in the lumbar

vertebrae and upper portion of the left femur. The diagnosis was confirmed in 3 of the cases at autopsy. There seemed to be no doubt about the fourth case because of the progress of the disease.

The author has observed in several cases the metastatic development of tumors following extraction of teeth in individuals one or 2 years after successful operation for carcinoma.

STENSTROM, WILHELM. Voltage in roentgen ray therapy. *Acta radiol., Stockholm*, 1924, iii, 167–175.

The opinion is expressed that the sphere-gap should be generally utilized as the standard instrument for measuring voltage in deep roentgen ray therapy, and should at the same time be used as a protection against excessive voltage. Roentgen apparatus and tubes should be standardized by means of ionization chambers. The question of dosage is altogether too important to permit neglect of the above points.

WASSINK, W. F., and VAN RAAMSDONK, C. PH. WASSINK. Roentgen radiation following radical operation for mammary carcinoma. *Acta radiol., Stockholm*, 1924, iii, 113–128.

A report is given on results obtained in 48 cases. Patients receiving prophylactic irradiation did not suffer from recurrence in subcutaneous tissue, in the axillae, ribs, sternum or clavicles. On the other hand, those who did not receive roentgen treatment often showed recurrence in these areas. No evidence was found that roentgen treatment had been harmful to the patients. When carcinomatous infiltration of the skin was present before operation, postoperative irradiation did not produce any durable results. The general conclusion is that postoperative irradiation is to be recommended.

ÅKERLUND, AKE. Diverticula of the stomach from a roentgenological point of view. *Acta radiol., Stockholm*, 1923, ii, 476–485.

The scanty statements found in the roentgen literature as to gastric diverticula appear, with two exceptions, to relate to so-called functional diverticula, all of which are believed to be misinterpreted diverticula of the small intestine, situated behind the stomach, and originating from the terminal part of the duodenum or from the duodenojejunal flexure. A report is made on a series of 5 cases roentgenologically diagnosed as organic diverticula of the stomach; 4 of these belong to the type of "congenital" diverticula localized in the cardiac region, the fifth one being a case of postoperative diverticulum within the canalis ventriculi. These were all verified and removed at operation.

Gastric diverticula are of greatest roentgenologic interest from the differential diagnostic standpoint. They are characterized by rounded shape, varying degrees of filling and distention, soft and mobile contour, and absence of roentgenologic symptoms of an infiltrative process in their surroundings. All the above cases showed residue of the barium meal after 4 hours, and each of the 4 cases of cardiac diverticulum exhibited, in the erect posture, a gas bubble in the upper portion of the diverticulum.

BISSELL, FRANK S. Chronic pulmonary streptococcicosis. *Radiology*, July, 1924, iii, 20–22.

Roentgenological observation of such cases showed absence of signs of tuberculosis, although they were referred with that as a tentative diagnosis. There were areas of peribronchial infiltration, sometimes associated with patches of bronchopneumonia and located usually below the third interspace. These features were usually unilateral and in association with thickening of the hilum and bronchial shadows. There was sometimes suggestion of pleuritic thickening. The peribronchial involvement appeared lobar in distribution and the areas of more diffuse density suggested recurrent bronchopneumonic processes. In several cases infected tonsillar crypts showed the presence of streptotocci and this suggested that the condition above described was a low grade streptococcus infection or a pathological state rather than an active disease process.

The author believes that this condition is almost as true to type as tuberculosis in the roentgenologic changes produced, although the diagnosis of streptotoccus infection frequently offers difficulties because of absence of sputum.

CARMAN, RUSSELL D., and FINEMAN, SOLOMON. The roentgenologic diagnosis of diaphragmatic hernia, with a report of seventeen cases. *Radiology*, July, 1924, iii, 26–45.

The experience of the Mayo Clinic shows an incidence of about 1 in 18,000 for this condition. Roentgenologic demonstration of diaphragmatic hernia usually offers no difficulty. Occasionally failure to observe this condition on first roentgenologic examination may be due to factors such as the following: The hernia may develop as a late sequel to paradiaphragmatic purulent processes; or it may result from trauma or lacerations of the diaphragm months after injury; or spontaneous temporary reductions may occur; or only one of a double hernia may be visible; or the opaque

medium may not pass through the opening because of strangulation or because of the patient's posture. If the hernia contents contain only solid viscera, the oral or rectal administration of barium cannot reveal the presence of a diaphragmatic hernia.

Cases of hernia of the kidney may be demonstrated with the aid of pyelography. Diaphragmatic hernia must be distinguished from mechanical elevation and true eventration of the diaphragm, hour-glass stomach, and esophageal diverticula. The length of the esophagus should be determined roentgenologically. Roentgenograms of the chest may give some evidence of the presence of abdominal viscera within the chest. Sometimes this evidence is extremely slight, and the hernia may be mistaken for some common condition of the chest. Pneumoperitoneum may be of aid in the diagnosis and differentiation of this condition. The determination of the exact site of the hernial opening is important for the surgeon in his choice of operative approach.

CLAESSEN, G. Three cases of roentgenologic niche in gastric carcinoma. *Acta radiol., Stockholm*, 1923, ii, 486–490.

Although reports on the subject seem rare, it appears that niches in roentgenograms of the stomach occur in cancer of the stomach, and are by no means pathognomonic of simple ulcer alone. The diagnosis between ulcer and cancer therefore becomes of great importance, since appearance of niche in the roentgenogram is an indication for medical treatment rather than operation. Three cases are reported with niches in the lesser curvature of the stomach in patients suffering from gastric cancer. The niches in all cases were located in the carcinomatous ulcer. In one case, the complaint lasted but four months, and in two others there was free HCl in the stomach. The size of the niches varied greatly. It seems clear that in the case of large niche one must be prepared to find cancer. Great importance is attached to the irregularity of the contour of the niche, as well as to the unevenness and contraction of the curvature.

GARDNER, BOYD S. Post-operative *x*-ray examination in dentistry. *Radiology*, July, 1924, iii, 74–75.

Too much emphasis cannot be placed on the value of routine postoperative roentgen examination in dentistry. It is of value from the standpoint of end-results and also from that of imparting knowledge to the operator. Roentgenograms obtained postoperatively make it possible for operators to accumulate definite data that should tend to standardize surgical technique, since the results of various operators can be compared.

GRANGER, AMEDEE. What produces the shadows in the aortic and hilar regions? *Radiology*, July, 1924, iii, 55–59.

The work of Delherm and Chaperon is reported on anatomico-radiological studies of the median cardiovascular shadow observed frontally.

LAMMERS, H. Radium treatment of cancer of the lip. *Acta radiol., Stockholm*, 1923, ii, 497–508.

This is a report on 47 cases of cancer of the lip treated by radium alone from 1915 to 1923. The result shows 39 cures and 7 cases which grew steadily worse and died in spite of the treatment. Of the 39 patients cured, 35 were still free from symptoms in September, 1923, the other 4 having been lost track of. These cases show cures lasting from 3 months to 9 years.

In the majority of cases the treatment consisted in the application of the calculated dose of pure gamma rays in a sitting lasting a day and a night. A plastic mold is constructed to fit the diseased lips and it is furnished with the radioactive material in the appropriate metal filter and a lead plate to protect contiguous structures. The patient necessarily suffers discomfort because the jaws have to be kept wide open.

LOMHOLT, SVEND. On the employment of radio-active matter in solution. *Acta radiol., Stockholm*, 1923, ii, 437–460.

The advantages of the use of thorium as a source of alpha rays for therapy are brought out. The procedure is easy, clean and agreeable from the standpoint of the patient and does not, like roentgen or radium radiation, entail risks of deep burns or of delayed harmful sequelae. In thorium-X the active element is the alpha ray and the deep effect on the skin is probably mechanical penetration by the substance or its transmutation products, especially emanation. To fully utilize the potency it is of importance to prevent escape of emanation. This seems best attained in therapeutic practice by covering with adhesive tape, thin gutta-percha, etc. The method recommended for use is the painting of the alcoholic solution of the substance on the affected portion of the skin, which is covered and left to be acted upon for about 5 days.

The reaction appears in about 24 hours as a slight erythema which then slowly increases with strong reactions, during the first 2 or 3 weeks. It may sometimes proceed to the

formation of bullae, in which case there may result a slight atrophy of the skin without injury to the dermal glandular organs. The only other unpleasant after-effect observed has been pigmentation of the treated area, which may remain for several months. The skin of the face seems less susceptible to pigmentation than the rest of the skin. The pathological changes very much resemble those produced by roentgen rays and consist of an advancing degeneration of the entire epithelium, reaching a climax after a fortnight, when regeneration commences. The changes in the corium are much less pronounced, but there is evidence of increase in the number of the cells and the appearance of a younger cell type. The cell changes are accompanied by transitory perivascular infiltration.

The effects of thorium treatment were observed in lupus erythematoides and in psoriasis. The clinical results consisted, as a rule, of a good symptomatic effect but relapse was almost the invariable rule, permanent cure being obtained in but very few cases.

LYSHOLM, ERIK. A new mercury interruptor. *Acta radiol., Stockholm*, 1923, ii, 512–515.

In the mercury interruptor described, the break is produced by a porcelain knife cutting a jet of mercury. The knife is inclosed in a porcelain casing, and consists of segments in the form of curved surfaces. The rotating portion has a heavy steel cylinder which acts as a fly wheel. The mercury is continuously purified by means of a filter arrangement.

LYSHOLM, ERIK. Apparatus for the production of a narrow beam of rays in treatment by radium at a distance. *Acta radiol., Stockholm*, 1923, ii, 516–519.

In this device for radium therapy at a distance, the radium is inclosed in a lead cylinder with walls 2 cm. thick. The open end of the cylinder is directed towards the patient and delivers about 25 per cent of its capacity of hardest rays. The dosage is varied by variation of the distance to the patient and by appropriate screens. The apparatus can be used as a gamma ray source alone, or as a beta and gamma ray apparatus by interposing a filter of copper between the radium and the patient. When emanation is used the apparatus can be made smaller, and for deep therapy a method of cross fire can be adopted.

POLAK, J. B. Pleuritis mediastinalis. *Acta radiol., Stockholm*, 1923, ii, 461–467.

This is a rare condition, only 26 cases being found in the literature. The case here reported was in a woman 58 years old who from her twentieth year suffered from gall stones, which necessitated three operations. Percussion revealed the existence of encysted exudate or of an encapsulated pneumothorax. Roentgenoscopy showed the heart retracted to the left. The shadow of the heart was intersected by a triangular shadow which had its apex at the root of the left lung and its base on the diaphragm; and judging from the parallax, it was situated behind the heart shadow. There was a clear portion at the base of this shadow which disappeared after about 100 cc. of air had been aspirated by puncture.

ROVSING, C. M. Trichobezoars in the stomach and their demonstration by roentgen examination. *Acta radiol., Stockholm*, 1923, ii, 491–496.

Roentgenoscopic examination of the stomach of a girl aged 8 years, who for some time had suffered from digestive disturbances, disclosed a peculiar picture corresponding fairly well with a picture of trichobezoar in the stomach published by Barclay. This roentgenologic diagnosis was confirmed at operation.

There was dilatation of the stomach and the baryta meal settled to the lower portion. Pressure showed the foreign body to be movable within the stomach shadow. The hair ball took on a reticular appearance due to adherent portions of baryta. The treatment must always be operative removal by gastrotomy.

SCHONS, EDWARD. A light-proof film cabinet. *Radiology*, July, 1924, iii, 48.

The cabinet is used in storing films for loading and unloading cassettes. Each shelf, one for each size film, will hold up to six dozen films in their black folders without other light protection. The shelves are slightly shorter than the films so that the latter project and can be easily removed. A large lower compartment is used to hold exposed films before development. The box is constructed of 5-ply birch with a sliding door which locks. The inside is finished in black.

SOILAND, ALBERT, and COSTOLOW, WILLIAM, E. The short wave *x*-rays in other than deep conditions. *Radiology*, July, 1924, iii, 23–25.

Objection is raised to use of the term "deep *x*-ray therapy" because of ambiguity in its meaning. Perhaps a more expressive term is "short wave *x*-rays," but even this is vague. The problem to be solved is the use of the voltage which will insure qualitative homogeneous radiation to the desired field. Criticism is expressed of present practice of quoting

electrical factors when describing dosage. It is claimed that such specifications cannot be reproduced at other times or places. On the other hand, expression of dosage in terms of erythema units is claimed to be reproducible by other operators. The belief is expressed that skin lesions *per se* are not in the category of short wave roentgen therapy. For different therapeutic levels the following voltage standards roughly outlined may be suggested: 80 to 100 kv. for skin and adnexa; 120 to 140 kv. for 5 cm. depth; 200 to 240 kv. for 10 cm. or more.

From results obtained in the treatment of malignancies with radium it seems logical to assume that by using rays of a similar nature produced by high voltage, good results might be achieved for extensive areas of superficial malignant growth. Several cases of clinical carcinoma of the breast with metastases to the axillary glands have cleared up under high voltage treatment, while others have shown very little improvement. It appeared from preliminary considerations that hypertrophied tonsils receiving 200 kv. through 0.5 to 1.0 mm. Cu for a short period should prove efficacious.

SANTE, L. R. A fracture table for fluoroscopic examination of fractures under extension. *Radiology*, July, 1924, iii, 46–48.

To obviate numerous difficulties experienced with present apparatus a new table was devised. The frame-work is essentially of the same construction as the Army portable unit, except that the present device is both longer and wider. To provide facilities for extension of extremities, the method in use with the Hawley table is applied. A perineal post is securely anchored in the middle of the table and Hawley extension arms and screws and adjustable supports are mounted on accessory rods running along the sides of the table. Two roentgenoscopic units are used, one underneath, and one at the side. These are oil-immersed to avoid danger from the high tension leads.

After obtaining proper position of the fragments in a fracture, a cast can be applied without disturbing the position of the patient on the table.

STRÖM, S. A contribution to the roentgen diagnosis of ulcus pepticum jejuni. *Acta radiol., Stockholm*, 1923, ii, 468–475.

It is believed that the importance of the niche symptom in the roentgen diagnosis of peptic jejunal ulcer is underrated. A niche may sometimes be demonstrated in cases of gastroduodenal and jejunal ulcers. The smooth and somewhat retracted contour of the jejunum in the vicinity of the ulcer seems to be typical. However, this roentgenologic features is sometimes caused by a spastic contraction, although organic changes in the intestinal wall may contribute to the effect. There is also a contraction of the circular muscles of the jejunum towards an ulcer, analogous to the spastic constriction seen in gastric and duodenal ulcers. The observation of these direct signs is facilitated by serial roentgenography. Five cases are described as illustrating the above points.

SUTHERLAND, CHARLES G. Shadows of calcified areas in the bony pelvis. *Radiology*, July, 1924, iii, 69–73.

Ray-opaque shadows in the bony pelvis have been found in 50 roentgenograms; only 13 of the 50 patients have been operated upon and form the subject of the present report. Of these 13, 8 had fibromas of the uterus; one, a fibromyoma of the left ovary with a corpus hemorrhagicum of the right; one, a partially calcified pyosalpinx; one, ovarian tumor containing rudimentary teeth; one, calcification of the ovary; and one, calculus in a diverticulum of the bladder. Outside of the bladder area such shadows in the bony pelvis are comparatively rare. The above 23 cases are briefly described.

TROELL, ABRAHAM. Another case of spondylitis typhosa. *Acta radiol., Stockholm*, 1923, ii, 509–511.

Back pain occurred as a sequel to typhoid fever in a man 36 years old. This symptom was accompanied by fever and a positive Widal reaction. A year later a roentgenogram disclosed a fairly broad, bridge-like, bony connection extending between the 3d and 4th lumbar vertebrae. There was no history of trauma and the solitary appearance of the bone changes, as well as their essentially protective character made the diagnosis quite clear and differentiated it from tuberculous spondylitis and spondylitis deformans.

ÅKERLUND, ÅKE. On a peculiar "film fault." *Acta radiol., Stockholm*, April 10, 1924, iii, 63–65.

The film fault discussed consists in the appearance of the label of the card-board container upon the roentgen plate. This is due to a more or less unique method of photographic reproduction known as "playertypy" and "luminography;" and it is due to the reflection of light from the white portions of the label which are in close contact with the sensitized plate. This phenomenon is of course avoided if the caution is followed to open the case of films only in a completely dark room.

WASSON, W. WALTER. The gross pathology of the chest. *Radiology*, July, 1924, iii, 49–54.

Attention is directed to the differences between general roentgenological characteristics which make one disease distinguishable from another by means of so-called cardinal signs or symptoms. The four great groups of chest diseases that are readily distinguished roentgenologically are tumors, irritants, infection and circulatory disorders. Subdivision of these four classes requires closer study.

AMUNDSEN, P. Blood anomalies in radiologists and in persons employed in radiological service. *Acta radiol., Stockholm*, April 10, 1924, iii, 1–7.

Examination revealed a deviation from the normal blood picture in roentgenologists and employees exposed to the radiation hazard. The total number of leucocytes is frequently less than normal. The most marked change was noted in the ratio of polymorphonuclear leucocytes and lymphocytes, there being a reduced percentage of leucocytes and a relative lymphocytosis. The percentage hemoglobin was nearly always normal. Effects seems to appear as early as one or two months; but after long leave of absence, the blood picture becomes distinctly improved. To lessen the hazard, it is recommended that improved means of protection be utilized on every occasion, because such recommendations, when carried out, have been followed by decided improvement in the blood picture of the permanent personnel of roentgen and radium laboratories.

ARNELL, SIGFRID. A plastic means of protection for the x-ray treatment. *Acta radiol., Stockholm*, April 10, 1924, iii, 66–67.

The protective paste consists of one part of paraffin, melting point 45°C., and 5 parts of litharge. A layer of this mixture 4.3 mm. thick has a protective capacity equivalent to lead sheet 1 mm. thick. The purpose of the paste is to facilitate the isolation of irregularly shaped surfaces, for instance, warts or chancroids.

To avoid danger from lead poisoning, a mixture of paraffin with barium sulphate was also produced. The greatest proportion of barium with which the mixture proved to be plastic was 3 parts barium sulphate to one part paraffin. One cm. of this plastic mixture equals 1 mm. of lead in protective power.

CLAESSEN, G. Radiation treatment in certain forms of surgical tuberculosis. *Acta radiol., Stockholm*, April 10, 1924, iii, 15–27.

A report is given of the results obtained in the ambulant use of quartz-light baths in 3 types of surgical tuberculosis; namely, tuberculous lymphadenitis, tuberculous sub-cutaneous abscess and ulceration, and spina ventosa. The lymphomata also received partial treatment with radium and roentgen radiation. The results obtained were so favorable as to make the use of stronger radiation appear unnecessary. In tuberculous lymphadenitis, the condition may be regarded as more or less localized so that local treatment is recommended; but in other forms of tuberculosis general light baths should be administered.

Experience with the disease (in Iceland) discloses an absence of lupus vulgaris in the vicinity of fistulas originating from tuberculous foci in the bones or soft parts. Minor surgical operations are necessary during the light treatment. Arc-light treatment is not necessary in the types of surgical tuberculosis above enumerated, and will undoubtedly be serviceable in serious cases of tuberculous lymphadenitis. Generally stated, quartz lamps are useful for the more superficial processes and arcs for the deeper tuberculous processes.

LARSEN, T., and LYSHOLM, ERIK. The question of post operative treatment of mammary cancer. *Acta radiol., Stockholm*, April 10, 1924, iii, 8–14.

The results of prophylactic postoperative treatment in 109 cases are presented. Seventy-six cases, under observation for at least 3 years, were treated with several series of small doses delivered through 4 mm. Al. Of this number, 47 are alive and have no demonstrable recurrence. In 26 cases with local, non-adherent tumor, there has been not a single recurrence. In 35 cases with adherent tumors, or involved axillary glands, 24 were found free from recurrence. Of 15 cases with glands in the supraclavicular fossa, only one remained free of recurrence.

Out of 33 cases irradiated with large single doses and deep therapy only 16 were alive and free of recurrence for one year. In all groups, a higher frequency of recurrence was found in cases treated with large single doses than in cases treated by series of small doses.

ODELBERG-JOHNSON, G. On fractures of the proximal portion of the radius and their causes. *Acta radiol., Stockholm*, April 10, 1924, iii, 45–53.

The material of the writer comprises 2 cases of extra-capsular transverse fracture of the neck of the radius, 35 cases of "chisel fractures" of the head of the radius, with or without a T-shaped fracture of the neck, and 6 cases of simple fracture of the neck of the radius in persons with an open epiphyseal line. Observation supports the view of Bruns as to the manner in which the chisel fractures

and fractures of the radial neck in children are produced. The fracture is produced by a blow in the longitudinal direction of the radius in pronation, the capitellum pressing down the anteriorly directed rim of the articular fossa of the radius. However this etiology is shown to be inconceivable without a posterior subluxation of the radial head taking place simultaneously. Experiments made on the elbow joints of corpses support this view.

RUNSTRÖM, GÖSTA. The roentgen picture of fresh subperiosteal hemorrhage in fractures of the metatarsals. *Acta radiol., Stockholm*, April 10, 1924, iii, 42–44.

Narrow, spindle-shaped deposits may be found in metatarsal fractures within the first few days after the trauma. These deposits do not occur in fractures with dislocations. The opinion is offered that these deposits are caused by subperiosteal hematomas resulting from subperiosteal fractures. The hematoma clotting beneath the intact periosteum becomes sufficiently dense and circumscribed to be visible in the roentgenogram. In military practice these conditions are frequently observed, partly as a result of so-called marching injuries without known trauma.

SMYRNIOTIS, P., and KRAFT, F. Differential roentgen diagnosis of dilatation of the renal pelvis. *Acta radiol., Stockholm*, April 10, 1924, iii, 28–41.

In order to provide more exact nomenclature for the different parts of the renal cavities, the authors propose the term "ampulla" for the so-called anatomical pelvis of the kidney, and pelvis for the ampulla and the calyces. The term calyx retains its present definition. The normal pelvis is classified into 2 types, one without and the other with an ampulla. Three forms of the latter type are described. The measurement of the capacity of a pelvis is described and criticized.

Dilatation of the pelvis may be divided into two classes according to the pathogenesis disclosed in the pyelogram. One is caused by retention of urine and the other by infection of the pelvis. In the first group three periods are distinguished; namely, dilatation of the ampulla, dilatation of the ampulla and the calyces, and finally, enormous dilatation of the pelvis with extensive atrophy of the renal tissue. These periods are described with aid of pyelograms, and the influence of secondary infection is discussed. There are also three periods in the second group; namely, simple destruction of the calyces, destruction and dilatation of the calyces, and finally, destruction of the calyces with dilatation of the pelvis. These various types are illustrated. Details of technique necessary for successful pyelography are discussed.

STRÖM, S. A case of intrathoracic cyst. *Acta radiol., Stockholm*, April 10, 1924, iii, 60–62.

Roentgen examination of a woman 39 years old revealed a foreign body of the size of a small orange in the right half of the thorax. There were no clinical symptoms of aneurysm, and since other positive signs were absent the patient was kept under observation for a month. A second roentgenoscopic examination revealed no change in size of the body. The diagnosis made was that of an intrapulmonary new growth, either chronic inspissated empyema or cyst of the lung. Operation disclosed a cyst $9 \times 5 \times 4$ cm. following the anterior surface of the spinal column between the pleura and the esophagus. Microscopic examination of the wall of the cyst showed it to consist of coarsely fibrous connective tissue with some gland-like formations but with no definite signs of pleural tissue. Such benign intrathoracic growths are very rare.

WESTMAN, AXEL. A case of myositis ossificans. *Acta radiol., Stockholm*, April 10, 1924, iii, 56–59.

This relatively rare condition was found in a boy 2½ years old. During a period of one year the process had developed considerable ossification in the muscles of the neck, the sides of the thorax and in the upper extremities. Pathological examination of the test excision from the right upper arm disclosed that the long ossification observed in the roentgenogram was located in the internal intermuscular septum without involvement of the surrounding musculature. There were no signs of a previous inflammation.

WESTMAN, AXEL. A simplified dosimetric method in gynecological deep roentgentherapy. *Acta radiol., Stockholm*, April 10, 1924, iii, 68–75.

A description is given of a simplified method for measuring the distribution of radiation within the pelvis in deep roentgen therapy. A phantom was made of plastic wax shaped to correspond to the pelvis of a heavily built person. A number of cylindrical holes were made parallel to the axis of this phantom and corresponding to half its depth. The holes were made just wide enough to permit introduction of the ionization chamber of the ordinary iontoquantimeter. This arrangement permits measurement at different places within the phantom. To simplify the problem of centering, the phantom was inclosed in a wooden frame in accordance with the suggestions of Jüngling, the spaces between the

frame and curved surface of the phantom being filled out with bolus alba. The results of the measurement on the phantom may be employed directly in therapeutic irradiations.

It was found that the simplest and best way to obtain homogeneous radiation of the pelvis was to employ 4 fields of entry and a skin focus distance of 60 cm. The apparatus used was the Coolidge tube with a Siemen's inductor, 0.5 mm. Cu. This gives a deep dose of 18 per cent at a depth of 10 cm. with a skin focus distance of 23 cm. and a field of entry of 6 × 8 cm.

BAEUCHLEN, E. Recent results with deep roentgen therapy of pulmonary tuberculosis. *Deutsche med. Wchnschr.*, May 23, 1924, I, 682-684.

The treatment was applied according to the Stephan method by means of an Apex apparatus, 28 cm. spark gap, 2 ma., 3 mm. Al filter. The whole thorax was irradiated in one distant field, with the rest of the body carefully shielded. Patients received 6 treatments, 3 weeks apart, $\frac{1}{20}$ to $\frac{1}{40}$ skin unit dose at a sitting.

Experiments on rabbits inoculated with bovine tuberculosis showed no notable effect on the course of the disease. However, much more favorable results in conjunction with specific therapy were noted in the clinical experiments in 22 cases. In 3 subfebrile cases that ceased to respond to other treatment, the roentgen-ray therapy was successful in procuring recovery that has lasted for 1 year. Asthmatic complications were eliminated in 2 out of 3 other cases.

The blood picture was followed, and it was noted that an increase in eosinophils seemed to be a favorable prognostic sign, but not *vice versa*. Increase of neutrophils need not be considered an ominous sign. In general, it is concluded that this form of roentgen therapy in conjunction with other approved measures is of definite value in pulmonary tuberculosis.

BARRINGER, B. S. Radium treatment of carcinoma of the bladder and prostate. *Canadian Pract., Toronto*, March, 1924, xlix, 147–152.

Treatment of bladder carcinoma depends upon the size of the tumor. Cystoscopic treatment is attempted for the smaller tumors. Radium seeds are implanted in the small indurated portions, and for the larger and softer tumor radium of 300 to 500 mc. is held up against the tissue as long as the endurance of the patient permits, 20 to 30 minutes usually being long enough.

For larger bladder carcinomas, suprapubic cystotomy is done and a combination of radium seeds for the indurated portions and screened radium is used. The immediate mortality of this operation is about 2 per cent for all sizes of tumors, and all ages. Discretino must be used in planting radium seeds about the neck and base of the bladder because of the great irritation that is induced.

Cancer of the prostate may be controlled for some length by the use of radium. In the 5 cases reported, all under observation for more than 5 years, the control with radium was fairly satisfactory.

BUXTON, St. J. DUDLEY. A radiographic survey of the normal joints. I. The shoulder joint. *Brit. J. Radiol.*, April, 1924, xxix, 115-134.

The roentgenologic details of the shoulder joint are considered in the present contribution. The best position for examining this joint is that suggested by McKendrick, using what he terms the normal focus point. The tube is arranged at a distance of 20 inches from the surface of the plate. The central point of the joint is placed near the center of the plate, and the central ray from the accurately centered tube is arranged to pass through the center of the joint.

The roentgenologic details include study of the glenoid cavity, the anterior view of the shoulder joint and its appearance in infancy, youth and adult life.

CYRIAX, EDGAR F. A case of displacement of the ilium of sixteen months standing: Painless reposition: Immediate recovery. *Brit. J. Radiol.*, April, 1924, xxix, 135–139.

The cases are illustrated by roentgenograms taken before and after replacement. The opinion is expressed that in cases of sacroiliac displacement the one proper method of treatment is reduction of the displacement. Strapping, rest, use of corsets, etc., may be ameliorative, but only direct replacement will yield permanent results.

DAVID, O., and GABRIEL, G. Capillary microscopy of roentgen erythema. II. *Strahlentherapie*, 1924, xvi, 372–380.

A study was made of the effect of variously filtered roentgen-ray mixtures with the aid of the capillary microscope, in conjunction with numerous filters and under control of the Seemann spectrograph. The Loose crystal filter was also utilized, the ranges measured being between 0.08 and 0.3λ. The Loose crystal filter corresponds analytically and according to the capillary microscope to 0.5 mm. zinc. The radiations were applied to fields on the back. Hypersensitive skin received only ¾ of the skin unit dose. Differences in reaction of

the skin to variously filtered roentgen radiations could be studied biologically with the aid of capillary microscopy. The more long-waved radiation received, the stronger was the capillary reaction, and consequently the strongest reaction occurred with unfiltered radiations. The reaction therefore runs parallel with the content of soft rays. In hypersensitive persons it is very much intensified. These observations furnish new support for the belief that soft rays produce stronger biological reactions. Roentgen rays are able to liberate the capillaries from spasm, apparently by injuring the nerve substance in the capillary wall.

DEGRAIS, and BELLOT, ANSELME. What is to be expected of the radium treatment of cancer of the cervix. *Canadian Pract., Toronto,* March, 1924, xlix, 177–181.

In the operable stage, 90 per cent of the cases of cancer of the cervix are apparently amenable to radium therapy. This figure represents the proportion of the more radiosensitive forms of tumors. The results compare very favorably with those furnished by surgery.

DODDS, E. C., and WEBSTER, J. H. D. The metabolic changes associated with x-ray and radium treatment. Brit. J. Radiol., April, 1924, xxix, 140–148.

Metabolic changes induced by roentgen and by gamma radiation have been found to be exactly similar. The changes produced vary with the site irradiated. No evident changes were observed when the head, thorax and extremities were exposed. Exposure of the abdomen and spleen produced definite urinary and blood changes. There was a sudden drop in urea, uric acid, ammonia, titrable acidity, creatinin, total nitrogen, phosphates and total volume of urine. Within three days the excretion of these constituents came back to normal. Chloride content and diastase showed immediate increase with return to normal in from 3 to 6 days. The feces showed an immediate increase in fecal fat content consisting almost entirely of neutral fat. These results indicate the temporary inhibition of the function of the liver, pancreas and kidneys.

Exposure of the neck produced only one effect, namely, a temporary disappearance of urinary creatinin. This effect is supposed to be due to the action on the parathyroids. In 3 cases of well-marked roentgen-ray sickness no changes in metabolism could be observed. It is concluded the effect was probably psychical. Cases treated prophylactically with various salts before exposure to radiation showed lessened reaction.

FINKENRATH, K. Quantitative radiation measurement in light therapy. *Strablentherapie,* 1924, xvi, 309–328.

Precise measurement of radiation is an absolute necessity for any work on the biological action of light. For every patient, the effect must be capable of determination in advance, and capable of being graded. The Fürstenau actinimeter satisfies these demands; it permits the production of the desired biological effect on the skin even when different sources of light for the same spectrum are used. Incorrect placing of the selenium cell and overheating of the cell are sources of error. The "light sensitiveness tester" permits, under similar conditions of irradiation, the irradiation of four positions of the body with different quantities of light. It consists of a stencil with four apertures. For the determination of erythemal effect, the "erythema meter" is used to give the intensity of reddening in numerical terms. In the interior of a convenient light-proof box is placed a source of light; by turning different filters between tube and skin, there is observed which filter number causes a disappearance of the difference between normal and erythematous skin. A control test of light sensitiveness is recommended for each case of dermatologic light therapy. This procedure might also reveal in a safe manner the existence of a roentgen hypersensitiveness. At any rate, a case of intense roentgen sensitivity also showed strong light sensitivity. Such relationships should be further investigated and confirmed.

HARRISON, FREDERICK C. Radium treatment o, skin cancer. *Canadian Pract., Toronto* March, 1924, xlix, 169–171.

In a series of 426 cases of rodent ulcer seen since 1910 the number of clinical cures has been 371, or 87 per cent. The treatment failed largely in cases in which the process had begun to involve cartilage or bone, when radium rays do not have the same selective action and the disease is difficult to arrest. Squamous-cell epithelioma is more malignant than rodent ulcer because of tendency to metastasize. In treatment it should receive powerful destructive exposure using unscreened plaques so as to get the benefit of the destructive beta rays. In pavement epitheliomas the treatment consists of plaques screened with lead, 0.1 mm. thick. This yields hard beta rays and gamma rays which cause destruction of new growth and stimulate the fibroblasts of the corium to a defensive reaction. The results in such cases show about 75 per cent clinical cures.

Epithelioma of the lip usually requires flat applicators in early cases and radium needles

or emanation seeds in the more advanced stages. In all cases gamma radiation of the adjoining lymphatic area is given as a routine procedure. Of 142 cases, 113 are clinically cured, some being free from disease for more than 10 years.

HEALY, WILLIAM P. Treatment of cancer of the uterus with radium and x-ray. *Canadian Pract., Toronto*, March, 1924, xlix, 161–169.

Report is made on the results of cases 3 years or more under observation. The results have been encouraging and it is believed this is due solely to the fact that heavy intensive irradiation of the entire pelvic field was practiced. It is believed that the percentage of apparently cured cases will increase as the technique improves.

Routine treatment of suitable cases of primary cancer of the cervix consists in the insertion of a so-called "cervix tandem" into the uterine canal, so placed that one capsule rests in the portio vaginalis and the other in or a little beyond the internal os. The filtration is 1 mm. platinum and 1 mm. black rubber tubing. The dosage administered is 300 mc-hr. of which ⅔ is in the vaginal cervix because of the difference in strength of the two capsules. The second portion of the treatment consists in the vaginal application of a "bomb" containing 1000 mc. of radium emanation screened with 0.5 mm. platinum.

HEILBRON, L. G. Modern radiographic technique. *Brit. J. Radiol., (Röntgen Soc. Section)*, April, 1924, xx 53–59.

It is recommended that the accuracy of time switches be checked. One device for this purpose consists of a spinning disk of lead with a small hole. It is easy to read off the hundredths of a second that the current has passed through the tube. An accurate idea of the focal distance is quite necessary since it is important to know the quantitative effect of the size of the focal spot on the image. The pin-hole method is not quite adequate, and the author describes a method for determining what he calls the "index of sharpness." A wire gauze is mounted on a piece of cardboard and placed at an oblique angle to the photographic plate. The top of the gauze is 20 cm. from the plate, and the tube is mounted so that the distance from the focal spot is 50 cm. Roentgenograms made in this way with different tubes reveal differences in the size of the focal spot. That part of the gauze which is close to the plate is always sharp but there are differences in sharpness of the image on the gauze at greater distances from the plate. It is possible to select a definite part of the shadow where the image begins to lose sharpness. The distance from the film to this part of the gauze is measured, and by dividing this height, (h), by (50 − h) the result gives the index of sharpness.

A metal hot cathode tube is illustrated. The hot cathode is a single wire; and a diaphragm before the target produces a focus on the target.

HOFFMANN, E., and SCHREUS, H. T. Regarding a delayed partial sclerodermoid injury following deep roentgen ray therapy, and the success of sympathectomy. *Strahlentherapie*, 1924, xvi, 381–388.

A patient, aged 21, suffering from erythema induratum of both legs received every 4 weeks 0.6 of the skin unit dose filtered through 4 mm. Al. This was tolerated practically without reaction. A year after the last irradiation and several days following a bump against a garden bench, there occurred a necrosis of the left leg ending in a phagedenic ulcer; and surrounding the ulcer there was a hard edema. The process was long drawn out and tedious, and finally no further progress in healing occurred for six months. Periarterial sympathectomy in the popliteal space brought prompt reduction of the ulcer to half its size. In the meantime, there arose on the right leg an extensive sclerodermoid induration of the size of a saucer. This also quickly receded after sympathectomy. There were present in this case all the characteristics of genuine scleroderma and not a suspicion of overdosing of the skin. Histologically the process was also scleroderma-like. The operative success might perhaps have been still more favorable had the operation been made in the inguinal region.

KELLER, P. On the action of ultra-violet light on the skin with especial respect to dosage. II. Individual and regional sensitiveness. *Strahlentherapie*, 1924, xvi, 301–308.

There are in use in practice two kinds of radiation with altitude sun; one is administered in small doses and avoids erythema, and the other is consciously applied so as to produce erythema. In both, information as to the dosage is important. In no case should more than an erythema of the first degree be induced. Three-fourths to one altitude sun unit is always able to produce a mild erythema upon the back of an individual not previously irradiated,—an erythema that causes no symptoms. There exist individual variations in sensitiveness to ultra-violet light, but they are not great and the erythema zones of different individuals are fairly

uniform. Special diseases are excepted; a case of albinism responded much more intensely, and a case of scleroderma responded one-tenth as much as normal skin. *Regional* sensitiveness is very variable. It is slightest on the legs and on the dorsal surface of the hand. It is dependent on the light exposure of the skin and upon still unknown factors, among which chronic blood stasis and the resulting reduction of the vitality of the tissue appears to play a special rôle.

KELLER, P. The action of ultraviolet light on the skin, with special respect to dosage. III. *Strahlentherapie*, 1924, xvi, 537–553.

Human skin was irradiated with 1/10 Finsen white light, and after intervals of 1, 5, 30 hours and 3 and 7 days, respectively, was excised for examination. The most striking effect of the ultraviolet light was the degeneration of the prickle cells. The cells of the horny granular layers never respond by degeneration, while the basal cells are only slightly affected. Before the microscopic demonstration of degeneration of the prickle cell layer, there must already be present toxic products from the affected cells, which products cause the accumulation of leucocytes in the peripheral vessels and capillaries of the papillae. The reaction is not uniform, some cells remaining relatively normal and in this respect, the effect is somewhat similar to that of roentgen radiation. The at first intact cells then degenerate secondarily; but their destruction does not appear to be due exclusively to the light. After an irradiation with ultraviolet light there finally occurs in a short time a complete renewal of the epidermis. At first there is no increase in pigmentation, but rather a distribution, which makes the effect macroscopically visible and which is produced by rise of pigment from the original basal cells. Seven days after irradiation, the pigment was found principally in the degenerated layers, and on the other hand, less than normal in the basal layer. Actual hyper-pigmentation makes its appearance later on. The reactions of the organism after irradiation are only partly a direct light effect, being mainly unknown interactions between inflamed skin and the rest of the body. The author, in an experiment on himself demonstrated for the first time an immediate light effect on tissue. Skin was irradiated with one-fifth Finsen light, and 4 days later was irradiated with *one* finsen light, and at once excised. The oxidase reaction of most of the leucocytes was lost to an average depth of 0.5 mm. in the doubly irradiated portion of the skin. This leads to the conclusion that leucocytes may undergo injury in the tissues when subjected to customary dosage of light.

LEE, BURTON J. Radiation in the treatment of mammary carcinoma. *Canadian Pract., Toronto*, March, 1924, xlix, 141–147.

The treatment of mammary carcinoma is most effective when full use is made of roentgen and radium therapy. No rountine procedure can be outlined to meet the requirements of individual cases.

A recent summary shows that 10 out of 54 primary inoperable cases were alive 3 years after the beginning of treatment; 4 of these have remained free from further evidences of the disease. In the recurrent cases there has been a considerable prolongation of life as compared with cases untreated by radiation. It is concluded that postoperative radiation has demonstrated its efficacy. Platinum filtered radium combined with roentgen radiation has yielded results thus far that have proven most satisfactory.

MAHNERT, A., and ZACHERL, H. The effect of roentgen rays on the body juices, and on the metabolism of the human organism. *Strahlentherapie*. 1924, xvi, 163–194.

1. *Changes in the Blood after Roentgen Irradiation.*

The effect of radiation upon the blood clotting power, lipoid content, antitryptic serum titer, sedimentation velocity of the erythrocytes, CO_2-combining power of the venous blood and serum proteins was studied. In all cases (women only being studied) the values were found changed as a result of irradiation. After intensive roentgen treatment, 2 different groups could be distinguished. Group I comprised afebrile cases with reduced blood blotting time, increased blood cholesterol and accelerated red cell sedimentation. Group II comprised febrile cases exhibiting effects opposite to those cited for the first group. Both groups consisted almost entirely of carcinoma cases. Cases irradiated prophylactically after operation, when clinically free of recurrence, had a slower sedimentation rate which was, however, less than the normal. Group I did not otherwise include only prognostically favorable cases. An increase in the inhibitive power of the blood serum on tryptic digestion was observed after mild as well as after strong irradiation. The content of blood serum, increased after strong irradiation, variations appearing to be dependent on the dosage. The CO_2-combining power was reduced after irradiation in cases with carcinoma. It is questionable whether the altered CO_2 tension affects

the clotting. The increase in antitryptic titer is explained as being due to the increase in blood cholesterol. The change in sedimentability of the erythrocytes can be brought into relation with the change in content of blood lipoids, or also, with cell breakdown. The cause of increase of acid in the venous blood is believed to be a change in cellular metabolism.

11. *Alterations in Metabolism.*

Since the utilization of nutriment is rendered difficult after heavy irradiation, the basal metabolism was determined by means of respiratory gas analyses; and the total metabolism was found by determining simultaneously the respiratory gas exchange and the urinary nitrogen output. The determination of the respiratory exchange for 4 to 6 hour periods was made on the fasting individual, before and on the day after irradiation. The basal metabolism determinations showed no appreciable changes following irradiation in cases of carcinoma or myoma. Total metabolism after irradiation in cases of carcinoma showed increased nitrogen output, increased uric acid excretion and carbohydrate synthesis during the fasting state. Frequently, in cases of carcinoma, carbohydrate synthesis is present during fasting even before irradiation. This observation is significant to the problem of the origin of carcinoma. Myomas and metropathies responded with a diminution in urinary output. The studies reveal the numerous and important changes in the organism caused by roentgen rays. Since the humoral changes in the blood are but temporary phenomena, the changes in the body after irradiation are to be regarded largely as alterations in condition and function of the tissue cells. This is also indicated by the metabolism changes which apparently are dependent on the nature of the tissue irradiated. There is a certain similarity to non-specific cell stimulation, except for the important difference that besides general reactions, distinct differences occur after irradiation, according to the nature of the disease.

MARTIUS, H. Roentgen radiation measurement in deep therapy practice. *Strahlentherapie*, 1924, xvi, 277–287.

An absolute measurement of the biologically effective dose must await the time when the energy effects in the human body produced by roentgen rays can be explained and measured. For relative measurement, the use of air ionization is especially suitable, and may be used either directly during irradiation (involving an equipment of expensive cable), or indirectly. In the indirect relative measurement, the hardness of the rays is determined in a hardness measuring instrument (Dessauer's electroscope), and the radiation intensity in the body is read off from tables; or the measurement may be made in the ionimeter described by Martius and Grebe. With the latter instrument the operator may conveniently determine the depth intensities for various focal distances, field sizes and ray hardnesses. An advantage is that the erythema time must be determined empirically only for a single ray quality, assuming that the measured intensity in the rays of different wave length parallel the biological effect. The instrument consists of a small ionization chamber and a string electrometer, which is charged by means of the small inclosed electrifying machine, and observed through a microscope. During any series of measurements, the same portions of the scale are always read. The percentage deep dose may be calculated readily by the aid of the water phantom. The curves give values corresponding to those obtained by the low atomic number ionization chamber and by physico-chemical methods. For the homogeneous, filtered rays found in practice, there exists a parallelism between experimental ionization effect and biological action; so that, with customary ray hardness, the skin erythema time and the discharging time of the ionimeter run parallel. It is therefore necessary to know the erythema time for only a single radiation.

PUGA, J. The scattered radiation conduit. A new device for attaining greater depth dose and more favorable dose distribution without increase of surface dose. *Strahlentherapie*, 1924, xvi, 288–300.

The radiation collector of Chaoul exerts its effect mainly on the surface. The device of the author increases only the depth dose without changing the surface dose. This device consists of a hollowed out block of wood upon which the patient lies and of two superposed side blocks which deepens the channel. Scattered radiation on the surface is absorbed by a ring-shaped lead screen lying at the surface of the body. Numerous measurements on a wood phantom with an ionimeter showed not only a considerable increase of the percentage dose, but more especially a very much more uniform distribution of the dose within the field of radiation. Instead of a maximum in the middle, there was found a corresponding minimum by use of this device. At a depth of 10 cm. the value in the center was increased from 39 to 47 per cent, at a point 5 cm. to the side the increase was from 35 to 50 per cent, at a point 10 cm. to the side the increase was

from 30 to 58 per cent (all these measurements being at the 10 cm. depth). Instead of the convex distribution curve obtained without the conduit, there was a concave curve with it. For sacral irradiation, there are two fields that yield homogeneous deep radiation. The patient lies in the conduit either in the prone or supine position; both side blocks are movable and permit adjustment to various body sizes. A compression mechanism reduces the total diameter of the pelvic region. In this manner the air spaces within the pelvis disappear and there results a homogenization of the pelvic section.

SCHWARZ, G. Radiation-biological studies of the problem of malignancy. *Strablentherapie*, 1924, xvi, 394–411.

A natural adaptation of the skin to roentgen radiation does not exist; on the contrary, the skin becomes more sensitive after a first reaction to roentgen rays. Benign growths exhibit at least no decreasing sensitiveness. On the other hand, decrease in radiation sensitiveness of recurring malignant tumors following radiation injury is a well-known fact. This roentgen acclimatization is explained as being due to qualitative changes of the specific tumor cells. These changes may be assumed to be modifications (inheritance of acquired characters) or selections (survival of more resistant elements). In this connection, the non-uniformity of the elements of the malignant tumor is to be noted. One may imagine that after an irradiation fewer roentgen-sensitive cell groups remain undamaged or only retarded, and that from these groups recidives develop. Growth acceleration of tumors caused by roentgen radiation might be explained as taking place through selective elimination of retardative roentgen-sensitive cell groups or through the inflammatory components of the roentgen reaction.

STRAUSS, O. The effect of roentgen rays on endocellular and metabolic processes. *Strablentberapie*, 1924, xvi, 195–207.

The Dessauer hypothesis of heat points is not convincing; but whether the action of radiation on cells is due to ionization or to other kinetic processes, the point of attack for the radiation lies in the cell colloids. How radiation influences the chemism of the cell is still unknown. The significance of the lipoids, at first over-estimated, is now underestimated. It was found that irradiation of the living organism results in a diminution of blood cholesterol. Normal physiological processes, like hemolysis and electrical isolation of the red cells, are associated in the body with a constant relation of cholesterol to lecithin. It is assumed that the cell membrane (whose existence is more postulated than proven) consists partly of cholesterol; and that lecithin is also very necessary for the permeability of this membrane. The cholesterol of the membrane is definitely affected by the radiation, the effect of the lecithin being thereby increased. As a result, the permeability of the membrane is also increased. It is, however, not claimed that the total radiation-sensitivity of the cell lies in the lability of its cholesterol. What has hitherto been regarded as the effect of radiation on chromatin is but the manifestation of cell death. It is a secondary response in the nucleoproteins due primarily to an effect on the lipoids.

TOVELL, H. M. X-ray examination of the upper abdomen for malignant disease. *Canadian Pract., Toronto*, March, 1924, xlix, 172–176.

This is a discussion of what can be done toward the diagnosing of upper abdominal carcinomatous growth, excluding the colon. The roentgenologic appearance of peristalsis is a valuable hint. The greatest help in diagnosis comes from observation of definite gastric filling defect. The diagnosis of early carcinoma is rather difficult to accomplish, largely because patients present themselves only after symptoms have become pronounced. Pyloric spasm or spasm at the lower end of the esophagus may be the first sign of carcinoma and should be carefully investigated. At the present time roentgen examination of gastric carcinoma, when properly carried out, may yield accurate diagnosis in 90 to 95 per cent of all cases. Such a figure is not approached by all the other methods of diagnosis combined.